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CONTROLLING DEVICES FOR SINGLE-PHASE TRAINS.

That the controlling devices for a single-phase car equipment need not be more complicated than for a direct-current car will be apparent at once from the fact that any of the methods now used with the latter type of car can be applied immediately to the former without alteration. It is evident that by selecting a suitably low value of trolley e.m.f. the familiar series-parallel arrangement of motors with rheostatic acceleration can be applied to series motors of the single-phase type equally as satisfactorily as to those of the direct-current type. Moreover, with the alternating-current equipment it is possible to substitute reactance coils for the resistors of the rheostats and thereby eliminate a considerable portion of the energy dissipated as heat in the control circuits during acceleration. In addition, with the single-phase car there can be obtained conveniently any desired number of voltages to be impressed upon the motor circuits, and there is thus no necessity for limiting the e.m.f. to a single value as must be done with direct-current equipments. To this latter fact is attributable the essential difference between the controlling circuits of single-phase and direct-current cars.

In most of the so-called single-phase railway equipments that have been installed in this country it has been necessary to arrange for operation by both alternating and direct current. The problem of the controlling circuits has usually been solved by providing one set of controlling devices for direct-current operation and another set for alternating-current operation, only a few of the parts being common to both sets. For this reason, the controlling devices on almost all of the cars designated as single-phase have seemed much more complicated than those employed with direct-current cars. Our present issue contains an article by Mr. Ralph W. Krass describing in detail the controlling circuits for purely single-phase cars arranged for multiple-unit operation in trains. The four motors of each car are connected at all times in parallel, the variation in the torque for acceleration being obtained by changing the e.m.f. impressed across the motor circuits. In order not to open the motor circuits and not to short-circuit the transformer coils when changing the connection from one transformer tap to another, use is made of small induction coils which act as auto-transformers when the circuits are closed and as series reactors when one terminal is disconnected. Thus the current supplied to the motor decreases somewhat just before being increased when the e.m.f. applied to the motor circuits is changed to a higher value, but the torque is continuous, the circuit is never completely opened and the sparking at the transformer contacts is negligible. In the installation described by Mr. Krass all of the main switches are opened and closed by pneumatic plungers, the compressed air for which is admitted by valves electromagnetically operated. For controlling the electromagnets, use is made of a low voltage obtained from a storage battery, the current being distributed by means of a 12-conductor cable. A continuation of this cable throughout the whole train allows a

single master controller on either end of any car to govern the direction of motion and speed of the train. It is not essential to install a storage battery for supplying energy to the electromagnets, because the required e.m.f. can readily be obtained from a tap on the main transformer; certain advantages, however, attend the use of the battery, as pointed out in the article in this issue.

Definition of the Electrical Properties of Conducting Line Wires.

A recent number of the *Elektrotechnische Zeitschrift* contains a report, referred to in the Digest, from a committee of the Elektrotechnischer Verein, on the definitions and magnitudes of the fundamental constants of line conductors, particularly with reference to multiple cables. The discussion is taken up from the theoretical standpoint very thoroughly. In the case of a pair of parallel overhead line wires, employed for single-phase transmission, or distribution, the linear inductance, capacity and charging current are all simple and well-known quantities. The case of three equidistant parallel overhead line-wires as used in three-phase transmission presents but little extra difficulty. When, however, the line wires are placed in underground cables, perhaps with dissymmetrical arrangement, the case is not so simple, and special formulas have to be employed. The article discusses a number of different cases and arranges them in tabular form for reference. The table shows that even a considerable departure from the symmetrical condition can be dealt with by slight modifications of the standard formulas. Considering how much high-pressure distribution is carried on by underground cables, the report is well timed.

Economy of Electric Pumping.

While steam-pumping machinery in large water works is operated with the highest economy of any class of steam apparatus of similar size, the reverse is likely to be the case in small water works. Direct-acting, deep-well pumps and direct-acting pressure pumps, which make little use of the expansion of the steam, are common. These appliances are inherently uneconomical and it is an easy matter to make considerable saving by the operation of such pumps electrically. In a class of water works where the air lift seems to be necessary on account of the volume of water which it required from the well, the conditions are not quite so favorable to large fuel saving by the use of electric power. Nevertheless, such cases are by no means hopeless, and should be studied carefully. In a small station where an engine is being run to give day electric service, the addition of the load imposed by city water pumping will not cause as great an addition to the fuel consumed as the operation of a small compressor. In some cases it is possible to do away with the air lift and substitute a vertical-shaft centrifugal pump placed deep in the well. Such pumps are now made with outside diameters as low as 10 in., and a capacity of 75 gal. to 100 gal. per minute. The centrifugal pump, like the air lift, is to be considered chiefly in cases where the output from a well must be increased. In many cases the output obtainable from a well is not sufficient to justify the additional expense of either an air lift or centrifugal deep-well pump. For wells of limited capacity the electrically operated deep-well pump, although troublesome at times, can be counted upon to give as good results per dollar invested as anything that can be installed. Rods and plungers must be pulled up frequently for repairs, but that has to be figured in as a part of the regular work of maintaining the plant. Most deep-well supplies are sufficient only for small towns and there are apparently few cities of over 10,000 population dependent on deep-well supply. In the larger towns deriving supply from rivers or shallow wells, the electrically operated pumps either of the plunger or centrifugal type are the principal ones to be considered. One of the inherent difficulties under which the small central-station plant labors is the underloaded condition of its engines during a large percentage of the time they are in operation. Few managers of small plants realize what this underloading means in the shape of increased coal cost as compared to the results which could be obtained if it were possible to keep engines more fully loaded. The same general rule applies to boilers. The more nearly the engine and generator capacity in operation corresponds to the load, the lower the coal consumption per unit will be, and the addition of a pumping load conduces admirably to this condition.

Switching Arrangements for Synchronizing Alternators.

In any central station employing more than two synchronous alternators, some system of synchronizing an incoming alternator has to be adopted. That is, where only one alternator is used in an isolated plant, no synchronizing device of any kind is needed. Where only two such alternators are operated in parallel, a switching arrangement of the simplest kind suffices to permit of synchronizing the second machine after the first has been started. When, however, a plurality of such alternators are operated together in varying numbers, a synchronizing switching system of some kind is rendered necessary. The subject has recently received elaborate analysis in the *Elektrotechnische Zeitschrift* by Herr J. Teichmüller. The various methods of wiring the generator switchboards for synchronizing are classified and compared. In this country, rotary synchronism-indicators are now in very extensive use, connected between the main busbars and the incoming machine terminals, in a very simple and effective manner, so that very little trouble is ordinarily met with in synchronizing. Moreover, so effective is the automatic action between alternators running in parallel, toward the maintenance of synchronism, that it seems possible for the central station of the future to dispense entirely with speed governors on its engines.

Recent Suggestions in Non-Newtonian Mechanics.

Ever since the days of Isaac Newton, both scientists and engineers have worked side by side in the firm mutual belief that the mass of a body—for instance, that of a rifle bullet—was constant, and did not vary with the velocity of the body. Not only do all the sciences of dynamics, kinematics, ballistics, etc., depend upon this condition as an essential postulate, but our whole theory of astronomy depends upon it also. Now the electronists, not content with overturning the fundamental theories of chemistry in regard to the atom, are hammering at the fundamental conceptions of length, mass and time. At this rate, if the electronists have their way, the whole basis of physical science will have to be reconstructed in thought, although the actual difference in fact will be insignificant in the vast majority of cases. Is it any wonder that respectable scientific gentlemen who have comfortably screwed down their ideas are objecting to the iconoclastic proposals that the whole scheme of natural philosophy shall be revised?

It is contended by the electronists that the mass of a body, on the electronic theory, is not constant, but increases with its

velocity. The change is admitted to be extremely small until the velocity approaches the velocity of light, and at this velocity the mass is claimed to become infinite. The velocity of a rifle bullet as it leaves the muzzle is so small by comparison with the velocity of light that the suggested change in the bullet's mass would be quite negligible for all practical purposes. Probably no massive body in our world ever can attain a velocity great enough to make the question parctically serious. But in the vast distances of space surrounding us there should be chance for obtaining a practical test of the Newtonian versus the non-Newtonian theory of mass. The easiest direction in which to apply such a test is probably in that of our moon. Her velocity indeed is small, by comparison with the velocity of light, but her angular position among the stars can be observed with great precision, and errors of position due to errors in velocity accumulate with time progressively.

Now, it is admitted by all the great astronomers who have investigated the moon's motion that there is a small but distinct unexplained discrepancy between the actual and computed orbits of the moon. Whether this discrepancy is of such a direction and character as might be accounted for by the electronic theory has not been authoritatively announced as yet, and perhaps much time will be needed to review the lunar theory with reference to this question. The latest suggestion in non-Newtonian mechanics is that when a material body moves with ordinary velocity it not only undergoes an infinitesimal increase in mass, but it also undergoes an infinitesimal shrinkage of length in the direction of motion, a shrinkage that cannot be directly observed because the foot-rule applied to the moving body will also necessarily shrink during the motion. One comfort the engineer has, and that is, however greatly the physicist's ideas may have to be shaken up by physical progress in the time to come, owing to the activities of those who busy themselves with electrons, engineering is likely to go on serenely using the same formulas, rules and tables as at present, including the good old Newtonian mechanics and Ohm's law.

QUANTITATIVE MEASUREMENTS IN RADIOTELEGRAPHY.

A very interesting paper has recently been presented by Dr. J. A. Fleming to the Institution of Electrical Engineers in London on the subject of measurements in connection with wireless telegraphy. Although wireless telegraphy is carried on by electromagnetic waves, which are fundamentally of the same nature as those employed by electrical engineers in the transmission and distribution of energy, yet the measurement of volts, amperes and watts in wireless telegraphy is much more difficult than the measurement of these quantities in ordinary wire-connected systems. This difficulty is not merely on account of the feebleness of the received signals, but is also due to the high frequency employed. For example, in wire-connected systems using frequencies of 25 cycles or 60 cycles per second, we have no trouble in measuring the resistance of the ordinary sizes of copper wires used. The inductance and reactance of such wires must, of course, be taken into account in determining their impedance; but all copper wires below 1 cm in diameter have the same linear resistance, for practical purposes, at these frequencies, as with continuous currents. When, however, we use wireless telegraph alternating currents with frequencies in the hundreds of thousands per second, the case is very different. The current does not penetrate deeply into the copper wires at such frequencies, and the power wasted is thereby much increased. If we call the ratio of the resistance at a high frequency to the resistance with continuous currents the frequency-ratio of resistance, then this ratio due to imperfect current penetration is a number very considerably greater than unity.

Dr. Fleming describes a differential air-thermometer suitable for measuring the frequency-ratio of resistance in short lengths of wire in the laboratory. Formulas are also discussed for the computation of this ratio. It appears that, both by measurement and computation, the frequency-ratio of resistance in bare copper wire 2 mm in diameter—about No. 12—was 5.5 at a frequency in the neighborhood of 500,000 cycles per second. Consequently, a No. 12 copper wire carrying alternating currents of this frequency offers more than five times as much resistance as when carrying direct currents, owing to imperfect penetration of the current—that is, skin effect. This effect is, of course, independent of that due to inductance and reactance. Moreover, the paper shows that if a bare copper wire 0.16 mm in diameter —about No. 14—be wound into an open spiral of 2 cm in diameter and 2.6 turns per centimeter, the effect of the spiraling is not only to increase the inductance of the wire, but also to increase the frequency-ratio of its resistance from 4.5 to 5.6, at a frequency near 500,000 cycles per second. In this case, the magnetic field set up by the spiraling tended to distort the skin effect and to crowd the current penetration into the portions of the wire's surface outside of the helix. The measurements also indicate that although a copper wire as fine as No. 32 (0.2 mm in diameter) has a frequency-ratio practically unity at 500,000 cycles per second, yet if a strand of 19 such wires be layed up into a cable, each strand being separately insulated, the frequency-ratio of the cable was about 1.25. Consequently, although stranding a big wire does help the current penetration at high frequencies, and materially reduces the frequency-ratio of resistance, yet it does not ordinarily bring down that ratio to so low a value as that belonging to one of the individual strands acting alone. As yet we have no formulas for this case.

In German-silver wire, the skin effect is much less than in copper, owing to the lower conductivity. The frequency-ratio of a German-silver wire 1.4 mm in diameter was only about 1.3 near the same 500,000 frequency. Bare copper strip is also low in frequency-ratio. Consequently, as wireless telegraph engineers well know, all copper conductors should either be flattened, or hollowed, or finely stranded, in order to avoid marked skin effect. In regard to standard condensers, Dr. Fleming stands by oil condensers, using carefully dessicated paraffine oil. The capacity of such standards, as measured at, say, 100 cycles per second, can, it is claimed, be fairly depended upon up to 1,000,000 cycles per second. For standard inductances, single rectangles of copper wire are recommended for high-frequency work, and flat spirals for lower-frequency work. The efficiency of a particular wireless sending spark station is then discussed. Commencing with 2620 watts delivered to the direct-current side of a rotary converter, 800 watts were handed over to the step-up transformer. Of this power, 445 watts reached the oscillation condenser, and 94 reached the sending antenna. Of this power the antenna radiated 78 watts, making the net efficiency of the plant, in this case, about 3 per cent.

J. P. Morgan & Co. Dispose of Chicago Railway Properties.

Official announcement has been made that J. P. Morgan & Company have disposed of their syndicate holdings in the Chicago Street Railway properties, which deal was put through in New York, Dec. 24. Through the terms of the deal the shares of the City Railway Company, the Calumet & South Chicago Railway Company, the Southern Street Railway Company and the Hammond, East Chicago & Whiting Railway Company go into the hands of a group of Chicago capitalists, and a new company is to be formed to take over these properties, to be known as the Chicago City & Connecting Railways Company. It is understood that the Morgan interests are to receive $54,697,500 for their holdings in the Chicago City Railways Company. About four or five years ago Mr. Morgan and allied interests purchased about 95 per cent of the outstanding stock of this company for $200 a share. The company at that time was capitalized for $24,310,000, the transfer thus netting a profit of several million dollars.

The only official information of the deal which has been given out comes from Mr. Ira M. Cobe, who has been acting for the syndicate of Chicago capitalists who made the purchase from Mr. Morgan. Mr. Cobe says in his statement: "An agreement has been entered into whereby about 95 per cent of the shares of the Chicago City Railway Company, all of the shares of the Southern Street Railway Company and all of the shares of the Calumet & So. Chicago Railway Company, all of the shares of the Hammond, East Chicago & Whiting Railway Company have been taken over by Chicago interests. This marks the passing of the Chicago City Railway Company out of the hands of the Morgan interests. These shares, together with certain bonds heretofore placed upon the properties, will be deposited with trustees who will issue securities based upon the stock and bonds deposited. The doings and policies of the trustees will, by the terms of the trust agreement, be governed by a board of directors, the personnel of which is as follows: Messrs. J. B. Forgan, John J. Mitchell, Samuel Insull, John A. Shoor, Edward Morris, T. E. Mitten, E. K. Boisot and Ira M. Cobe.

The separate corporate existence of the several properties will continue. T. E. Mitten will remain as president of the Chicago City Railway Company, and will probably at an early date occupy the same position in the organization of all the roads. By vesting the ownership of the shares heretofore mentioned in trustees, under the proposed agreement, complete unity of management and operation of all the surface lines in the southern division of the city is accomplished. Whenever a feasible plan shall be worked out for a consolidation of all the surface lines operated in Chicago, then as to the southern division it can be dealt with from a practical standpoint as one ownership, thus greatly lessening the difficulty of harmonizing a number of interests."

This consolidation is considered as an initial step toward the organization of a large holding company, which may eventually take over all the public utilities of the city of Chicago. This company, it is predicted, will not only include the surface lines and elevated lines of the city, but will take in the electric light and gas concerns. A company with a capitalization of $400,000,000 is mentioned as being necessary to finance this extensive venture. The transportation companies of the city, together with the Commonwealth Edison Company, now represent a total capitalization in stocks and bonds of $326,514,281.

The four companies combined in the merger have stock issues of $24,310,000 and bonds of $26,425,000, a total of $50,735,000. The Chicago City Railway Company is by far the most important member of the group, its stock amounting to $18,000,000, with bonds of $20,000,000. The roads mentioned have 410 miles of single track and carry in the neighborhood of 320,000,000 passengers a year.

One feature of the combination is that it will greatly simplify interurban railway connections with Chicago from the South and East.

Federal Corporation Tax Law.

By George Hiram Mann.

The new Federal corporation tax law, part of the Payne-Aldrich Tariff Bill, is causing considerable uncertainty not only among corporations, but to the officials at Washington. Only an intimate knowledge of the peculiar circumstances under which this tax became law can reconcile one to realizing that so important and radical a piece of legislation was actually enacted while the millions of dollars of invested capital to be affected sat by in trance-like indifference, as it were. The tariff bill had already passed the House and was in the Senate when the Federal tax, backed by all the prestige of the Taft administration and sponsored by Attorney-General Wickersham and Senator Root, was presented at the Senate, and, after a short debate, accepted. The simile of Moses bringing the tablets down from the mount seems to be the only one strong enough with which to compare the charmed changelessness of the phraseology which emanated from the White House.

The tax, which covers the calendar year 1909, and which is 1 per cent on net profits, affects all corporations organized for profit having capital stock represented by shares whose net income exceeds $5,000 per annum. The sworn reports on which the tax will be computed must be made by the corporations before March 1, 1910.

The mooted questions in connection with the tax are many and perplexing. Probably the chief query now is: What is a reasonable allowance for depreciation? This remains unanswered, thought it is likely that the Commissioner of Internal Revenue will give opinions from time to time on this and other questions.

A number of suits to test the constitutionality of the act will be brought, some of them having powerful backing. It is the opinion in Washington, however, that both Senator Root and Attorney-General Wickersham believe the act to be constitutional, and that the tax will be collected.

Considering the overwhelming importance of this act, and the likelihood that the Federal camel, whose nose may be likened to the Corporation Tax, will endeavor to force the rest of his body into the corporation tent, the students of constitutional development, and especially those that view with uneasiness the expanding administrative power of the Federal Government, are watching the situation with keen interest. Apparently the world moves very rapidly these days.

The Morgan Telephone Deal.

Considerable of the interest attached to independent telephone conditions has centered about the office of the Attorney-General at Columbus during the past week, but at the same time nothing decisive has yet been done by that official or any one else. While an announcement was made a few days ago that the department is obtaining evidence to the effect that the Bell interests are taking over Independent properties in the Middle West, just what course is being pursued to obtain this information is not known. As to the purchase by J. P. Morgan & Company, the general idea conveyed is that the securities were obtained for the bankers' own account, and that the companies will be operated under directions from the New York office under policies similar to those which have been in use in the past. Those who had part in the negotiations with the firm were not informed as to the final disposition of the stock, and the only instructions F. H. Goff had was as to prices, and he kept well within them in the sale.

The only feature that has indicated that any affiliation with the Bell companies is contemplated is the advance in the toll rates charged by the United States Telephone Company and preparations on the part of certain of the Independent companies to make connection with the Bell long-distance lines. It is claimed that some of the rates now charged by the United States Telephone Company are practically prohibitive, and were made for the purpose of driving business to the Bell lines. As

the rates of the American Telephone & Telegraph Company have been allowed to remain as they have been for some months past, there is in reality some grounds for the speculations that have taken place.

Among the Ohio exchanges which have either made or are preparing to make connections with the Bell lines the following have been mentioned: London, Washington C. H., Millersburg, Wooster, Orrville and Bellefontaine. The exchanges at London and Washington C. H. are practically owned by the Citizens' Telephone Company, of Columbus, which was among those going to J. P. Morgan & Company. At Bellefontaine the Bell lines could not secure a franchise while the Independent strength was at its height, but when the advance in rates by the United States Telephone Company was made, there was a revulsion of feeling on the part of the city government and a franchise has been granted the American Telephone & Telegraph company for its long-distance lines.

The holdings of the banking firm in Ohio now amount to about 101,000 telephones and 40,000 miles of long-distance lines, with about 50 exchanges, counting those which the purchased companies control as subsidiaries. The companies have an aggregate capitalization of $12,500,000 bonds, $1,500,000 preferred stock and $11,000,000 common stock. The value of the property acquired is estimated at about $23,000,000, and the firm secured control by the payment of something like $10,000,000.

Officers of all the companies have received letters from J. P. Morgan & Company, stating that money will be furnished for all needed improvements and extensions, and instructions were given to proceed with the business in just about the same way that it has been conducted in the past. The independence of the companies is to be preserved, according to the understanding gained from the letter, and no changes are to be made in the management, for the present, at least.

Mr. Frank A. Davis, president of the Columbus Citizens' Telephone Company, was called to New York last week and it is understood that J. P. Morgan & Company offered him the general management or supervision of all its properties in the Central West, but no information has been made public as to the conclusion that has been reached. It is said that Mr. Davis hesitated to make a change because it would necessitate the removal of his home from Columbus to some other city.

Montreal Municipal Plant.

On Dec. 21 the property holders of the city of Montreal decided by a majority of 365 in favor of the corporation establishing an electric lighting plant, for which $2,000,000 may be borrowed. The authority given by the ratepayers is optional, and the probability is that the present City Council will not have time to deal with the matter, as the municipal elections take place early in February. The total vote cast was only 2855 out of 20,000 duly qualified electors, showing that very little interest was taken in the question. All the English-speaking wards were against the by-law, but this was more than offset by the vote of ratepayers in the French-speaking districts in favor of the by-law.

National Independent Telephone Association.

The newly elected board of directors of the National Independent Telephone Association held a meeting in Chicago on Dec. 20 and 21 and elected Mr. Frank H. Woods, president of the Lincoln Telephone & Telegraph Company, of Lincoln, Neb., as president of the association for the forthcoming year. Mr. Woods is also a member of the executive committee of the directors, and associated with him on that committee are Messrs. Theodore Gary, Macon, Mo.; W. J. Uhl, Logansport, Ind.; E. B. Fisher, Grand Rapids, Mich.; Charles West, Harrisburg, Pa.; H. D. Critchfield, Chicago, and Max Koehler, St. Louis, Mo.

Mr. Joseph B. Ware, Grand Rapids, Mich., was elected secretary and treasurer of the association.

Resolutions were adopted indorsing the Continental Telephone & Telegraph Company. In these resolutions it is said that this company has been engaged in the formation of a comprehensive long-distance telephone and telegraph company to operate in conjunction with the Independent telephone companies in the United States and Canada. It is the announced intention of the company to provide long-distance telephone and telegraph facilities from points west of the Missouri River throughout the entire country to the Atlantic Coast. The company now owns properties aggregating more than 200,000 telephone stations, it is said. The directors of the association formally indorsed this company and commended it to all Independent telephone men.

Lightning Protection on Niagara Lines.

The transmission lines of the Niagara, Lockport & Ontario Power Company running from Niagara Falls, Ontario, to Syracuse, N. Y., have recently been equipped throughout their entire length with a device designed by Mr. L. C. Nicholson, of the Buffalo office of the company, which is said to afford excellent protection against lightning troubles. A metal ring is supported on the frame of the tower just below the lower petticoat of the insulator in such manner that the distance between the line wire and the ring is shorter than the distance between the line wire and the insulator pin. The ring, which surrounds the insulator and is larger in diameter than the latter, is thoroughly grounded to the tower, so that the tendency would be for a lightning discharge to jump the shorter distance between the line and the ring, in preference to the longer route to the pin, and thence to the ground. Moreover, the arc, if there be any, in crossing the path thus formed is kept away from the insulator and trouble due to arcing is minimized. The device is claimed to have met all expectations.

Electrification Prospects at Boston.

Press dispatches from Boston state that at a recent conference between Governor Draper of Massachusetts; President C. S. Mellen and Vice-President T. E. Byrnes, of the New York, New Haven & Hartford Railroad, on the transportation situation at Boston, the subject of suburban electrification on the New Haven lines was discussed. Under a law passed by the Legislature of 1909 the control of the Boston & Maine Railroad passed to interests friendly with the New Haven system, and marked improvements in the handling of traffic are anticipated as a result of this change. The conference is of particular significance in view of the forthcoming session of the Legislature.

A feature of this situation is the falling off in traffic which the suburban lines of the New Haven have suffered since the opening of the Forest Hills extension of the Boston Elevated Railway Company. Estimates have been made in railroad circles that 60 per cent of the New Haven suburban traffic passing through the Forest Hills district has been deflected to the elevated line, and the Boston Elevated Railway Company states that by actual count the patronage of the Forest Hills extension is now 31,000 passengers per day. It is evident that the suburban traffic on the steam lines running out of Boston is immediately responsive to improved facilities on the street and elevated railway lines, and that electrification must come sooner or later if the standards of service are to reach the best levels.

Colorado Water-Powers.

At a Wednesday luncheon of the Denver Electric Club, held at the Kaiserhof Hotel, on Dec. 22, an interesting address was given by General Irving Hale, of the General Electric Company, on water-power from the standpoint of the electrical engineer.

In Colorado, the first water-power development was at Roaring Fork, in the Aspen Mining District, the initial installation being a 45-hp generator, utilizing a head of 400 ft. and voltage of 500 direct current. This gradually grew to much larger proportions and supplied the entire Aspen district. The second installation was at Ouray, the third at Telluride, gradually de-

veloping into the present Telluride Power Company, and the fourth at Silverton. In the second installation, 900-volt direct current was first used, but subsequent installations were with alternating current, at first single-phase and as soon as three-phase transmission was developed this system was substituted for the original installations. For these original installations a rich mining district made possible the water-power development, owing to the enormous prices of coal and the lack of any means of transportation.

General Hale then spoke of the fact that while the public so often has the impression that the water supply of the country is inexhaustible and cheap, this is very far from being the case; that water-powers as compared with steam developments usually have enormously higher initial costs, owing to the fact that the inequalities in water flow at different seasons must be equalized to some extent by the construction of expensive reservoirs. The public's idea is usually gained during the heavy flow off in the summer without regard to the minimum stream flow in the winter season.

As to the claims that water rights should be free to all, the fact was developed that thousands of excellent water rights taken out all over the State by individuals have failed through inability to secure financial backing, owing to the problematical demand and great cost per horse-power of development.

Taking up the United States Forestry departments system of charges for the water rights, the validity of the Government tax on the difference in level of the forest reservations was questioned. The other Governmental tax for maintenance of a steady flow by the preservation of forests was also questioned on the grounds that this steady flow was in no wise sufficient and that reservoirs are in all cases necessary, and also that the reservoirs themselves assist in the conservation and that they are thus rather beneficial than otherwise. This tax was to be considered rather as a tax on the development of the community. As to a coalition of water-power interests, owing to the multitude of water-powers and the active competition from steam and gas-engine plants with their comparatively low cost, this is extremely improbable. The General advocated the withdrawal of restrictions which would retard the development of water-powers with their possibilities for supplying light, railways and manufacturing, in districts which otherwise could not be properly developed.

The Denver Electric Club has been in existence only a month, but its plan for combining a weekly lunch and an interesting discussion of some live topic by men of the best acquaintance with their subjects, is proving of very great service to its members. At the close of General Hale's talk, a few pertinent subjects were proposed for future discussion by Judge Beaman, of the Colorado Fuel & Iron Company.

British Columbia $6,000,000 Electrical Extensions.

General Manager R. H. Sperling, of the British Columbia Electric Company, who has returned from attending the annual meeting of the company at London, England, announces that the directors have given authority for the expenditure of $6,000,000 in improvements and extensions to the company's power, lighting and railway plants in British Columbia, bringing the total capital invested in the Province up to over $19,000,000. Some of the work covered by this large appropriation is already under way, but the greater part has not yet been announced. The plans call for increasing the car-building shops at New Westminster so that they will double their present output. Two hundred thousand dollars will also be spent on new rolling stock. A new terminal station will be erected next summer at New Westminster costing $60,000. A new office building will likely be started early in the new year, to be built upon the site of the old office at the corner of Hastings and Carrall Streets in Vancouver. Two hundred thousand dollars has been appropriated for this purpose. The railway extensions include seven miles through the municipality of Burnaby; one and one-half miles in South Vancouver, which will shortly be completed and in operation; seven miles extending the Powell Street line to the new exhibition buildings, and two and one-half miles in North Vancouver through the Lynn Valley. In Victoria the generating station on the Jordan River will be completed; work upon this power house is now proceeding and it is expected that power will be ready for delivery in Victoria before the end of next year. About $1,500,000 will be expended upon this plant. Several other important extensions to the company's system is planned for Victoria and Vancouver Island. In Vancouver about $600,000 will be expended upon the gas plant, quadrupling its present output, and $200,000 additional will be expended in the construction of new mains. Considerable improvements will also be made to the Victoria gas plant, and several miles of additional mains laid. A steam auxiliary station will be erected in Vancouver, which will ensure continuity of service in case of accident happening at the Lake Buntzen generating station.

Hydroelectric Scheme for Simla, India.

Proposals for utilizing water-power existing in the hills round Simla, the summer capital of India, lying at a height of from 2000 ft. to 8000 ft. above sea level, for the supply of energy for industrial purposes and also for lamps and motors in Simla itself, have long engaged the attention of the Indian Government. It is not too much to say that the development of such proposals has been hampered by the difficulty of finding capital for the purpose, whether in India, in Europe or in America. The application of capital to industrial work in India has been slow as regards capital raised purely in India. In regard to capital from outside India, it will suffice to quote the instance of the Bombay Tramways Company, Ltd., which was floated with American funds and from the winding up of which the stockholders have lately retired with a large profit on their original stock subscription, in addition to the very handsome profits realized during the whole time of the duration of the concern in question. The results of the foregoing considerations was that the question of the "electrification" of Simla was found to be one which had to be taken up by the Government, if it was to be initiated at all. It was thereafter decided to utilize the available water-power of the Nanti Klad, a stream about 18 miles, by road, from Simla for the purpose of supplying electricity for lamps and motors in Simla, and that this work should be done by the agency of Government combined with the agency of the Simla municipality. It may now be of interest to give a brief description of the proposed electrical work for its features of engineering interest.

There can be derived from the stream in question about 1000 brake horse-power without damming, or collecting water by reservoirs; as the collection of water for use in the dry season of March to June is not difficult, there is no reason to doubt that the output of the plant to be presently installed might rise to a very much larger total in the near future. As to the sale for the energy to works situated on the site of the presently proposed works, it will suffice to say that Simla has a population of 40,000 and that there is a large timber-producing district within reach, with boat haulage to the site of the development. There is also a railway 60 miles long connecting Simla to the standard-gage railway system of the plains of India. This railway is owned by the Government, and forms the greater part of the mileage of Indian lines. Simla is at present more of an administrative center and a summer health resort than an industrial center.

The applications of electric energy at present contemplated are for the operation of the existing steam water-works, the opening out of additional supplies of water by electric motors to supplement the existing supply of 200,000 gal. daily, and the general public supply of electrical energy in Simla. In opening out the new water supply it has to be kept in view that it will be extended, as the future demand arises, to 1,000,000 gal. a day. This work having received the approval of the Government, plans and details were prepared, and these are now under

the final consideration of the Government, so that the plant will shortly be arranged for and set to work. A start has been made with the civil engineering work involved, which, of course, will occupy the most time to construct.

Among the principal features of interest in this scheme is the situation of Simla, itself on a ridge with deep valleys all around the town. The absence of suitable timber very near the works, and the abundance of stone and lime, make it possible to construct a substantial cement flume line at a moderate cost. On the other hand, there exists, where it is needed, an abundance of suitable timber for poles. The exceptionally high lift required from the waterworks perhaps is also a leading feature, this lift being 1300 ft. in the existing waterworks and on the new waterworks 2700 ft. It should be added that there is a gravitation water supply, which varies in volume according to the season, but cannot be extended, and that the additional supplies referred to join with this and supplement it. A tunnel 1200 ft. long is required on the works flume line; it is lined with very hard limestone. A reservoir will be constructed holding about eight hours' supply of water for the power plant at full load, and from a point near this the customary steel penstock pipes will deliver the water to the station under a head of 550 ft. All these works are situated about 5000 ft. below Simla. The transmission line will be 12 miles in length, operated at 15,000 volts, and the distribution low-tension three-phase.

As communications are rather difficult, and a good deal of special road making has to be done, it has been necessary to limit the size and weight of the various parts of the plant. It will be of interest to trace the future development of this plant as the provision of electric energy gives rise to future public demand, and as the demand which experience has shown to be inevitable calls for the installation of additional equipment.

The Electrical Industry in Siam.

A United States consular report gives figures showing that while five years ago the imports of all kinds of electrical supplies into Siam amounted to only $107,913, during the year ended March 31, 1909, they amounted to nearly $300,000, of which $18,672 were from the United States, an increase of $14,526 as compared with the preceding year. The principal countries from which electrical goods were imported during the years ended March 31, 1909, were Great Britain ($113,084), Germany ($79,081), Sweden ($52,222) and the United States ($18,672).

Light and power for Bangkok is furnished by the Siam Electricity Company, a Danish company. Its equipment includes Babcock & Wilcox boilers, Brush dynamos, and a Curtis turbine. The distributing e.m.f. is 100 volts at 100 cycles, single-phase. The company began operations in September, 1890, and is the only electric supply company in Siam. It furnishes the electric power and light for the city of Bangkok, both public and private, and also supplies the electric power for the 25-mile, single-track, overhead-trolley system of tramways. This company represents an investment of $1,500,000, and paid a dividend last year of 12 per cent and a bonus of $1.50. The original shares were issued at about $50 each, and at last quotation were valued at about $180.

The telegraphs are owned and operated by the Government. The telegraphs and posts are under one directorship. The income from these two departments for the year 1906-7 was $352,381, and the expenditures $427,275, leaving a deficit of $74,894. Siam has, up to the present, no wireless telegraphy in operation.

The Government also owns and operates the telephones. A new installation was finished this year. It is of the central-battery system, for 1500 subscribers. The rate is $5.50 monthly. The contractors for this work were a firm of Stockholm, Sweden, and, as noted above, Sweden is credited with $52,222 worth of imports of electrical goods for last year. There is a uniform duty on all electrical goods at 3 per cent ad valorem.

Electrical Working Considered by American Railway Association.

At the semi-annual convention of the American Railway Association in Chicago on Nov. 17 a short report was presented from the committee on electrical working. The American Railway Association is composed of company members representing the great railroad systems of the United States. At the Chicago meeting there were about 200 representatives of the railroad companies present, including presidents, vice-presidents, general managers and lesser officials. Mr. F. A. Delano, president of the Wabash Railroad, is the president of the association and presided. The secretary is Mr. W. F. Allen, of New York. About 250,000 miles of railroad were represented at the convention.

The committee on electrical working consists of Mr. George Gibbs, chairman, chief engineer of electric traction, Long Island Railroad; Mr. J. F. Deems, general superintendent of motive power, rolling stock and machinery, New York Central Lines; Mr. J. D. Isaacs, consulting engineer, Union and Southern Pacific systems; Mr. W. J. Harahan, assistant to president Erie Railroad; Mr. C. S. Sims, second vice-president and general manager, Delaware & Hudson Company; Mr. L. C. Fritch, chief engineer, Chicago Great Western Railway; Mr. E. H. McHenry, vice-president, New York, New Haven & Hartford Railroad. Its report is dated Oct. 18, 1909. It is short, and as it is of importance as a carefully considered expression of opinion from a committee of the leading steam-railroad companies of the country in relation to electrification, it is given in full, as follows:

"The committee on electrical working held its first session in New York City on Oct. 6, 1909. At this session the permanent organization of the committee was effected by the election of Mr. George Gibbs as chairman, and discussion had of its best usefulness to the association.

"In the short time elapsing between organization of the committee and the meeting of the association, it was impracticable to prepare a lengthy report, or, indeed, to formulate definitely the lines of action which will be of greatest usefulness to the association. When it can be done properly, a report will be presented to the association, giving the present status of electric traction as applied to railway operation under steam-railroad conditions. In the meanwhile, the committee holds itself in readiness to make recommendations upon specific questions.

"As this committee supersedes the committee on standard location for third-rail working conductors, and as the latter committee had at the date of its last report some questions still under consideration, it was decided by the committee on electrical working to appoint a subcommittee, consisting of Messrs. Gibbs, Fritch and Isaacs, to give special consideration to third-rail and overhead working conductor clearances.

"Another subject discussed by the committee and considered by it of present importance is that of standardizing the location of electric connections between cars of passenger trains, especially the connections of electrically equipped cars for multiple-unit train operation. The connections are required for controlling current to the cars, for heating, lighting, etc., and they occupy considerable space at the ends and between platforms of coupled cars. It is considered that it will be useful to the members of the association to have information as to these electrical requirements, as well as suggestions for standard locations which will permit of their proper installation without interfering with the functions of other connections, such as couplings, air brakes, etc. A sub-committee, consisting of Messrs. Deems, Harahan and McHenry, has, therefore, been appointed to consider this subject in order that it may be brought to the attention of the association as soon as practicable.

"A third subject has been considered by the committee, namely, the effect of the electrical working of railways upon automatic signaling systems. The conclusion of the committee will be brought out fully in a subsequent report, but it may be of use to the members of the association to know that the electrical working requires the adoption of an alternating-current

track circuit for signals instead of the direct-current track-circuit control heretofore in general use. It would seem advisable, therefore, that in the installation of any new automatic signaling an alternating-current track circuit should be employed and that extensions to existing systems should also be made in the same way. This recommendation applies not only to roads contemplating the adoption of electric traction, but to those in localities where electric traction is, or may be, employed upon nearby roads."

The meetings of the association are not open to the public, but so far as can be learned, there was no discussion on this report, which was accepted. The committee was continued.

Competition in Telephone Service.

Mr. J. B. Ware, of Grand Rapids, Mich., secretary and treasurer of the National Independent Telephone Association, addressed the Electric Club of Chicago at its weekly luncheon on Dec. 22, on "Telephone Development and the Benefits of Competition." Mr. F. P. Vose, the president of the club, after a gracefully worded reference to the amenities of the season, said that the club had listened the week before to one who advocated monopoly in the telephone-exchange business (Mr. Sunny), and, being fair-minded, it was now pleased to entertain an advocate of the competitive idea.

Mr. Ware at the outset briefly sketched the history of the use of the telephone in this country, referring to the early competition in the business between the Bell and the Western Union companies. This early competition was fortunate, in the speaker's judgment, in favoring the rapid development of the invention. But from about 1882 to 1894 there was a practical legal telephone monopoly in this country in favor of the American Bell Telephone Company. Mr. Ware presented figures to show that the average gain in telephones installed during this period was only a little over 8 per cent. From 1894, when there was the first possibility of competition, to 1904, there was an average gain of 64 per cent a year in the number of Bell telephones installed. This showed the benefit of competition on the Bell companies themselves.

In 1907, according to the census figures of the United States Government, there were about six million telephones in use in this country, and this number was about equally divided between Bell and Independent companies. In the number of companies engaged in exchange service, however, the disparity in favor of the Independents was very great, the number of Independent companies being 22,900, whereas there were about 30 Bell licensed companies. The speaker believed that the remarkable growth of the telephone industry would have been impossible without the spur of competition. Better still, the quality of service was greatly improved by reason of the same spur. The introduction of metallic circuits was given as one evidence of an improvement forced by Independent competition. Mr. Ware also doubted whether the granular carbon transmitter would have been adopted generally without competition.

Only through the spur of competition is it likely that the residence business in cities and telephone business generally in small communities would be extended. Telephone rates vary, not according to the cost of service, but according to the classification of service. It is a business of averages. There is a temptation to develop the highly profitable class of service and neglect others; competition corrects this in a large measure. It is difficult, even by municipal regulation, to force a monopoly to develop telephone business in the outskirts of cities or in small towns and villages. The people of the United States generally have found this out, and the growth of Independent telephone systems has been the result. If 15 or 20 large cities were deducted from the Bell telephone returns, the remainder would make a woeful showing in comparison with the corresponding Independent figures.

Referring to the argument against useless duplication of telephones by competition, Mr. Ware said that this danger was greatly over-estimated. He gave figures resulting from checking the telephone directories of 43 cities where competition exists and showed that in a number of Illinois cities outside of Chicago under these conditions the duplication of telephone subscribers was 8.7 per cent. The average in other States is not far from this, Kansas City, Mo., with its 13.7 per cent, having practically the highest proportion of duplications found. The speaker believes that competition means better service and better rates, although he did not go into the question of rates extensively. Monopoly, he thinks, means slow development and inferior service.

In closing, Mr. Ware cited the example of the Citizens' Telephone Company in Grand Rapids, Mich., an Independent company, which has paid 8 per cent dividends regularly for 12 years. He said that he believed the Independent telephone-exchange industry offered a safe field for investment.

Cost and Depreciation of Steam and Hydroelectric Installations.

In the discussion of the paper by Mr. Henry L. Doherty presented before the American Institute of Electrical Engineers on Dec. 16, Mr. Calvert Townley and Dr. Cary T. Hutchinson gave much valuable data relating to the cost and depreciation of steam and hydroelectric installations. The estimate given by Mr. Townley on a 5000-kw hydroelectric development having a peak load of 4000-kw at the generating station and an average yearly load-factor of 30 per cent, was $125 per kilowatt for the development up to the transmission line. A 4000-kw substation equipment would cost $8 per kilowatt and a transmission line $50,000; the average loss in the line and substation was estimated at 10 per cent. The minimum flow of the assured steam being equivalent to 1000 kw, it would be necessary to install a 2500-kw steam relay with a 50 per cent overload range; the steam relay equipment would cost $100 per kilowatt of rated output. The annual labor and maintenance cost to operate the hydraulic station, substation, and to maintain the property, would be $25,000, and the cost to operate the steam relay plant and supply the inefficiency of power during two months and to hold it ready for emergency service at all times would be $3000 per year.

TABLE I.—COST OF 5000-KW HYDROELECTRIC DEVELOPMENT AND STEAM RELAY.

5000 kw at $125	$625,000
Pole line	50,000
Substation, 4500 kw at $8	36,000
Steam relay, 2500 kw at $100	250,000
Total investment	$961,000
Fixed charges, 10 per cent	$96,100
Operating and maintenance cost of hydraulic plant	25,000
Operating and maintenance cost of the steam plant	3,000
Total annual cost	$124,100

The total annual output of the above plant would be 13,140,000 kw-hours, of which 10 per cent would be lost in transmission, leaving 11,826,000 kw-hours for sale. The total cost per delivered kw-hour would be 1.05 cents.

The service assumed above could be obtained from a 4000-kw steam turbine plant, having a 50 per cent overload range, located at the point of utilization. Such a plant would cost $100 per kilowatt of rating. The labor and maintenance charges would be $25,000 per year. The coal consumption would be 3 lb. per kw-hour at a cost of $3 per long ton.

TABLE II.—COST OF 4000-KW STEAM TURBINE INSTALLATION.

4000 kw at $100	$400,000
Fixed charges at 12 per cent	48,000
11,826,000 kw-hours fuel cost	47,304
Other operation and maintenance charges	25,000
Total operating and fixed charges for the year	$120,304

On the basis of these values the cost per kw-hour would be 1.01 cents, which is slightly less than the estimate for the hydroelectric installation.

Table III shows an estimate made by Dr. Hutchinson as to the proportional cost of the several items entering into the total investment of a medium-head hydroelectric generating and transmitting plant.

TABLE III.—SUBDIVISION OF COST OF PLANT.

Item.		Proportional Cost.
1. Riparian rights for dam and flowage basin, real estate franchises, organization expenses, preliminary legal expenses, cost of financing, removal of railroads, highways, bridges and all expenses preliminary to actual construction work		20.00
2. Permanent construction, dam, power house and water ways, etc		30.00
3. Equipment of power house		14.00
4. Transmission System—		
a. Right of way	4.50	
b. Copper	1.50	
c. All else	7.00	
Sum		77.00
5. General expense, engineering, administration, legal, etc		11.00
6. Interest during construction		12.00
Total		100.00

Item 1 of Table III covers the many costs that must be met, exclusive of the actual construction costs; Item 2 is principally made up of rock excavation and concrete. Item 3 is for the usual equipment, comprising water wheels, generators, switchboard apparatus, transformers and the various small parts of the power-house equipment. Item 4 covers the transmission system, including substations. Items 5 and 6 are self-explanatory. Of these items only 2, 3 and 4, comprising in all 57 per cent of the total, are subject to depreciation, and of these the greater portion of No. 2 is not subject to depreciation, as it covers rock excavation and concrete almost entirely. In Table IV is shown the depreciation of the several parts of the installation.

TABLE IV.—DEPRECIATION OF SYSTEM.

Items of Table I.	Proportional cost.	Assumed life years.	Annual amount for depreciation, in per cent of total cost.
1.	20	..	....
2.	30	50	0.168
3.	14	20	0.458
4.	13	20	0.415
5.	11	..	....
6.	12	..	....
			1.041

The annual charges being compounded at the rate of 4.5 per cent, the equivalent average life is about 39 years.

The various items forming the power-house equipment were assumed to have the costs and depreciation shown in Table V.

TABLE V.—COST AND DEPRECIATION OF EQUIPMENT OF POWER HOUSE.

Item.	Proportional cost.	Life years.	Annual amount for depreciation per cent of total cost
1. Stop logs, gates, and other wood exposed to air and water	0.80	5	0.146
2. Flooring, roofing and hardware, and miscellaneous fixtures	0.80	15	0.472
3. Tile wainscoting, sewage, plumbing system and metal window frames, etc	2.45	15	0.118
4. Electric light and telephone	0.80	10	0.065
5. Switchboard equipment	4.35	10	.355
6. Cables and heavy wiring	3.90	10	.318
7. Cranes	1.25	15	0.060
8. Water wheels	33.75	25	0.157
9. Water wheel governors	2.90	10	.235
10. Generators and transformers	40.00	25	.898
	100.00		3.423

An annual depreciation of 3.423 per cent represents an equivalent average life of 19 years for the power-house equipment. The transmission line costs and depreciation were given as in Table VI.

TABLE VI.—COST AND DEPRECIATION OF TRANSMISSION LINE.

Item.	Proportional cost.	Life years	Annual amount for depreciation in per cent of total cost.
1. Right of way	45.	..	..
2. Towers	18.4	15	.885
3. Special structures	5.1	10	.415
4. Insulators	2.1	10	.170
5. Copper	23.7	25	.530
6. Installation	5.7	..	..
	100.0		2.000

A 2 per cent depreciation is equivalent to a life of about 26 years for the transmission line.

TABLE VII.—DEPRECIATION OF SUBSTATION.

Item.	Proportional cost.	Life years.	Annual amount for depreciation in per cent of total cost.
1. Land	6.0	..	..
2. Buildings	30.	25	.67
3. Transformers	40.	20	1.28
4. Switches, etc.	16.	10	1.29
5. Installation	8.	..	..
	100.		3.24

The equivalent average life of the substation is 20 years. An estimate of the relative fixed charges on steam and water-power generating plants, expressed in per cent per annum, is given in Table VIII.

TABLE VIII.—FIXED CHARGES OF STEAM AND WATER-POWER GENERATING PLANTS.

	Steam.	Water.
Interest	6.00	6.00
Insurance	0.50	....
Taxes	0.50	0.50
Depreciation	5.00	1.00
Obsolescence	5.00	1.50
	17.00	9.00

In Table IX are shown the estimates for the cost of energy in cents per kw-hour for steam and water-power plants. These values are based on the assumption of a fixed annual charge of $13.60 per kilowatt plus an output charge of 0.5 per kw-hour for the steam plant and a fixed charge of $20 per kilowatt of demand on the water-power plant.

TABLE IX.—COST AND SELLING PRICE OF ENERGY PER KW-HOUR AT VARIOUS ANNUAL LOAD FACTORS.

Per cent. Load factor.	Cost of kw-hour in cents. Steam plant.	Water plant.	Selling price water power.
15	1.54	1.52	2.44
25	1.12	0.91	1.46
33	0.97	0.69	1.10
40	0.89	0.57	0.92
50	0.81	0.46	0.73
60	0.76	0.38	0.61
75	0.71	0.31	0.49

It is evident that at a high value of load-factor the hydroelectric plant can show a much larger profit than the steam plant, while the profits decrease as the load-factor becomes less. In the last column of Table IX is shown the price, at various load-factors, at which energy from the hydroelectric plant must be sold in order to produce a profit of 6 per cent on the investment.

Low-Tension Feeder Calculations for Street Railways.

At a joint meeting of the Electrical Section of the Western Society of Engineers and the Chicago Section of the American Institute of Electrical Engineers, held on Dec. 22, Mr. R. H. Rice, assistant engineer, division of electrical transmission and distribution, of the Board of Supervising Engineers, Chicago Traction, read a paper on "Low-Tension Feeder Systems for Street Railways," which was followed by interesting discussion, during which Mr. H. M. Wheeler, assistant chief engineer, Chicago Railways Company, presented curves and methods useful in studying the interrelation of headway, speed and time and distance spacing of cars.

Mr. Rice first called attention to the extent of the surface transportation facilities in Chicago. The rehabilitation of the railway companies included 687 miles of track, the cars on which are operated from 15 distributing centers with a total rating of 95,000 kw. Only two of these distributing centers are steam-power plants. The calculations of the feeders for supplying electricity for these systems were based on the operation of 2264 cars. Alternating current at 9000 volts is purchased from the Commonwealth Edison Company and transmitted to substations. At the present time direct current is distributed to the cars at a pressure a little below 600 volts. When the rolling stock has been rehabilitated and the old motors replaced by those of later design 600 volts will be carried on the distributing network. The trolley wires are all sectionalized, and each section is fed through one or more independent cables. Trunk tie lines between the substations are not used, but certain sections of the trolley wires are fed from two stations, and the total capacity of these double-fed sections is sufficient to answer the need for tying together two stations. In case of a breakdown one station can thus distribute current through the trolley sections jointly fed, and this current in turn be distributed from the busbars of the inoperative station.

Mr. Rice described very completely the methods followed in calculating the design of the overhead construction and dealt in particular with the system used in determining the proper location for substations and the size of feeders. The length of

trolley sections is determined by operating conditions. Preliminary to this work it was necessary to obtain a figure for the power consumption of a standard type car. Fifteen tests, extending over three days' time, were made for this purpose. The cars were equipped with meters and careful logs were kept. Also, typical trolley-wire sections were chosen and arrangements were made to keep a careful count of the number of cars on the section and to measure the power fed to the section from the substation. As the maximum peak of the day in Chicago occurs in the afternoon, the above investigations were carried on from 12 m. to 8 p. m.

To determine on what basis to design the feeders, careful curves were plotted showing the railway load throughout the day. It was interesting to note that for one substation on the Chicago Railways Company the maximum swing is 15,600 kw. A two-hour average value was chosen as a basis for the maximum load to be fed out of a substation. Considering that a potential of 600 volts is carried on the direct-current busbars, a capacity of 40 kw per car was used to determine the required substation capacity. An average drop of 50 volts was to be permitted in the direct-current distribution system.

In the work preliminary to laying out the distribution system a map of the railway is first drawn and the location of the cars during the afternoon rush-hour is shown. With a demand of 75 amp from each car the concentrated load on each trolley section is next indicated on another map of the section. With these concentrated loads thus exhibited the center of gravity or the center of load is obtained in a way similar to the solution of a problem in moments. The number of amperes on each section and its relation to the center of load for the district determine the location of the substation and the capacity of the generating apparatus in that station. After the substation locations have been so chosen a feeder-route diagram is made showing the location of the trolley feeders on the streets, their size and loads. The ordinances under which the Chicago Railways Company and the Chicago City Railway Company are being rehabilitated specify a certain territory within which all feeders should be carried underground. Mr. Rice exhibited drawings showing the typical feeder connections and stated that the underground work was built with a view to future increase in load.

Mr. E. N. Lake, division engineer of electrical transmission and distribution, Board of Supervising Engineers, Chicago Traction, called attention to the lack of literature on the subject of feeder calculations for large street-railway systems. It is interesting to note that, based on the 1,000,000 circ. mil cable, which is taken as standard, and an assumed load of 800 amp and an allowable drop of 50 volts, 6000 ft. was found to be the limiting economical distance for feeding. In other words, under these conditions the ideal street railway system would have its substations so located that the average length of cable would not exceed 6000 ft. Two of the largest street-railway systems in Chicago now have an average length of direct-current feeder of 6700 ft.

Practical Operation of Electric Trucks.

The regular monthly meeting of the Electric Vehicle and Central Station Association was held at the Massachusetts Institute of Technology, Boston, on Dec. 20, with President F. J. Stone in the chair. President Stone opened the meeting with a pleasing reference to the "attitude of Missouri" on the electric vehicle question, as indicated by the progressive work of the Anheuser-Busch Company and the Union Electric Light & Power Company of St. Louis. Discussing a recent visit to New York, he stated that in one commercial house 32 out of 35 motor-vehicles were of the electric type, and the head of the transportation department stated that the cost of operation of the electric was one-third that of the gasoline machines. This was accounted for by the lower cost of insurance, tires, labor and repairs. In another house 20 electrics out of 23 trucks were in service, the first electric machine having been in operation nine years. In another case it cost only $65 per month to cover garaging, cost of energy, care and minor repairs of a five-ton truck of the electric type. In the case of a gasoline truck the gasoline alone amounted to this sum. This electric machine makes 13 trips per day, carrying 65 tons of freight; whereas the company's horse-drawn vehicles could make only eight trips with a total of 40 tons for the day's work. The electric vehicle with a 10-ton total weight easily climbed a 7 per cent grade. Four tow horses had to be used with the horse-drawn machines. This electric machine was making daily runs of 25 miles.

Mr. Stone said that Postmaster Morgan, of New York, is most enthusiastic over the record of electric vehicles in United States mail service. Some of the cars in New York have averaged 51 miles per day since entering the service. One of the batteries ran 5955 miles before any cleaning or other work was done upon it. Many of the largest concerns in the country are using electric vehicles with complete success. The work and expense in the development of this field are not as great as many central-station organizations seem to think.

The paper of the evening was prepared by Messrs. Frank A. Clark and Albert L. Clough, of Manchester, N. H., on the "Use of Electric Trucks at the Works of the Amoskeag Manufacturing Company, Manchester," one of the largest textile plants in the world, and employing over 16,000 persons. Mr. Clark is electrical engineer of the company. On account of his enforced absence the paper was read by Mr. Day Baker, of the General Vehicle Company, Boston. The Amoskeag company has five trucks in operation, all being of the electric type, and with haulage ratings varying from 1.5 to 5 tons. These operate mainly in the mill yards, which are over 150 acres in area, with a maximum length of two miles. Electric haulage was introduced about 2½ years ago in place of horses. A three-ton Columbia truck was the initial installation. The latest equipment is provided by the General Vehicle Company. It is probable that in the future all haulage by horses will be superseded in the plant. There are about 15 miles of concrete and paved roadways in the yards. The results indicate that there is a large saving in electrical operation compared with horse traction.

The company maintains a garage 90 ft. long and 70 ft. wide, the building being of fireproof construction and the approaches of tar concrete. The floor is of cement concrete, drained to the sewer. In the main the interior finish is white. Enclosed arc lamps provide the general lighting and each post carries a receptacle attachment from which an incandescent lamp cord may be carried over the floor. The wiring is in underground conduit or molding, and automatic sprinklers are in service, with standpipe and hose connections. The heating of the garage is effected by overhead pipes supplied with steam from the company's power plant. Compressed air service is available for cleaning and tire inflation. The sides of the garage are equipped with lockers, drawers, shelves, cabinets, compartments, and sacks for the storage of supplies, with a workbench for light repairs. A steam-heated distilling equipment is installed, with provision for the filling of carboys and the supplying of all parts of the floor with distilled water for use in the batteries. A concrete washstand is installed, and beneath each car is provided a drip pan of galvanized iron coated with asphaltum to avoid damage from spilled electrolyte.

A runway is installed over which cars may be operated for changing batteries. Between the guide rails of the runway is the platform of a hydraulic elevator which is used to lift the batteries to the cars and to take them away. A chain-and-falls is installed for handling the batteries. The garage is also provided with an inspection pit, and tire-setting machinery and apparatus for lead burning are installed. The batteries are charged either from the company's 10,000-kw private plant or from the lines of the local central-station organization, through a 37.5-kw motor-generator set. A feature of the switchboard is a Bristol recording ammeter, with locked cover, its record acting as a check upon the employees as to the times of starting and stopping the charging and the number of cars on charge. An adjustable water rheostat, with water and sewer connections, is provided, and also a Cutler-Hammer rheostat with a range

of from 5 amp to 60 amp, used frequently in charging ignition batteries. Charging plugs are located upon each post in the garage, and special holders are provided to protect the plugs from defacement through rough usage. A steam-heated sand supply is installed, as all cars carry sand boxes for use on the grades of from 10 to 17 per cent which are found in the mill yard. The reserve equipment consists of three complete batteries on trucks, and a full line of tires, chains, gears, brush rigging, cell parts, etc. So far as possible the equipment is standardized, in order to minimize the number required in the stock section of the garage. Batteries on the reserve list are charged at a low rate, not exceeding 10 amp. The nightly service charges of the batteries are 12 hours long, and consequently at a lower rate than that specified by the battery makers. The low rate conduces to long life.

Thorough inspection of the cars is made nightly, covering all contact parts, the filling of cells with distilled water, tests of a pilot cell, and recording of troubles. Chauffeurs report for duty in the morning in time for oiling and a general inspection of the mechanical equipment of each truck. A minute mechanical inspection is made of each car on Sundays. A blue print of each battery with cell numbers is posted in the garage, to facilitate the handling of the cells and the making of records. Each battery is washed three times during its life. In this installation the company makes a practice of renewing each battery once a year, including negatives, positives, and separators. As each car is run from 20 to 25 miles per day, or about 7000 miles per year, it is found better to renew all parts than to use the negatives twice over. Use is made of solid tires which last for about 5000 miles. Tops are used only in rainy weather. The drivers are mostly employees formerly occupied in the handling of horse-drawn vehicles, a slight increase of pay being granted to chauffeurs. The majority of the care are run over the same route daily, the principal use being to transfer rolls of goods between different mill departments. The cars are out of commission for from 0.4 per cent to 1.4 per cent of the time. The latest trucks purchased are equipped with single motors, commutated field control, silent chain transmissions and anti-friction countershafts and wheels, and they handle the same work with 30 per cent less energy than the older trucks with two-motor equipment, series parallel control, spur gearing and plain bearings.

In the discussion, Mr. Baker stated that the mileage was affected about 12 per cent in winter on account of the icy grades, but the cars negotiate the hills at all seasons. Two men constitute the maintenance force. He called attention to the fact that a yearly renewal of the batteries is the most severe condition which one can ordinarily find, and yet the company is convinced that there is a very substantial saving in the use of the electric vehicle compared with horse-drawn equipment. The cost of energy is an insignificant item from the mill plant, but even if the company had to pay 4 or 5 cents per kw-hour the energy charge would still be a small factor in the situation. Mr. F. J. Stone cited the use of eight electric trucks in the yard of the Pacific Mills of Lawrence, Mass., and of similar equipment in the mills of the Pepperill Manufacturing Company at Biddeford, Me., and of the Nashua Manufacturing Company, Nashua, N. H. The meeting closed with a short review of the advantages of the electric pleasure vehicle in its field or urban and suburban service. President Stone stated that the association will shortly have a meeting devoted to this particular subject, and cited the remarkable growth of electric pleasure vehicle service in Rochester, N. Y., several vehicles being used in the same family in one or two cases. Mr. S. G. Thompson, of the Studebaker Company, described a successful pleasure vehicle trip to Plymouth and Pawtucket.

Steam Trawlers and Ocean Cables.

Increasing attention is being called to the respective rights and relations of steam trawlers and of submarine cable owners. During the last quarter century the deep-sea fishing industry has been largely remodeled upon the basis of the small steamer towing a net. At the present time there are more than 2000 of these steam trawlers under register; about 80 per cent of them are British, comparatively few being in service, as yet, on the American coast. They are usually about 120 ft. long, with a few hundred tons displacement, and with engines of 80 hp. They operate either singly or in fleets of half a dozen, all over the shallow waters of western Europe, from the Arctic circle to the southern limit of Morocco. They have gradually increased their working depths until now they operate down to 300 fathoms or over. Each boat usually carries a crew of nine men in all, and the operating expenses of a trawler are about $500 weekly. Consequently, the steam-trawling interest represents in the aggregate a large personnel, invested capital and food supply for Europe.

The methods employed to keep a steam-trawl net moving over the sea bottom are very interesting. The net is commonly about 60 ft. wide at the bottom, and is fastened to two boards, one at each end of the foot-rope, or lower edge of the net. These boards, called otter boards, are about the size of a billiard table, and are made up of wood slabs, some 3 in. thick, rimmed with iron. They are water kites, being held near the center of one face by a steel rope and fastening. The steel rope forms the kite string, the otter board the kite, and the trawl net the kite tail. When the steamer goes over the ground at a speed of 2½ or 3 knots the two otter-boards skim over the bottom, each towed by a steel rope. They keep nearly in a vertical plane and tend to pull apart like a pair of kites heading away from each other, but kept in harness by the trawl net between and behind them. Such fish as come within the scope of the advancing net are unable to escape the rush of water, and are finally hauled up by winding in the steel ropes.

Steam trawlers naturally work along and across the numerous ocean telegraph cables, the nets and otter-boards passing over them hundreds of times without any interference. Occasionally, however, an otter-board engages a cable. This is either because there is some slight projection on the edge of the board, or possibly because the cable may be festooned from one submarine hillock to another, thus permitting the otter-board to work underneath the cable. When a trawler is unlucky enough to engage a cable it is a battle between rope and rope. The trawler winds in her warps as best she can. If the cable is very strong and taut, and the water deep, the warps break and the trawler loses net, catch, otter-boards and warps, to say nothing of time and temper. If, however, the cable is not very strong, the warps may hold and the cable may break, involving the cable company in much loss of money for traffic and repairs. Or the cable may be raised to the surface and be disengaged by the fishermen without rupture, but yet be injured, and put out of working order, by reason of the sawing and chafing it is subjected to under the plunging of the trawler in a heavy sea. In any case, the danger to the cable is very great.

Representations and protests have been made to the British Government latterly with increasing vigor by the representatives of the cable companies, particularly by the Atlantic cable companies, which claim that, off the coasts of the British Islands, their cables have been broken by trawlers nearly 40 times within the past 10 years. They regard the steam trawler as the greatest existing menace to submarine cables, and intimate that some day cable communication between Europe and America may be entirely severed by these depredations.

A board of inquiry was appointed last year by the British Postmaster-General, and this board has since published its findings, as well as the testimony taken from both of the parties in interest.

A suggestion was made, on behalf of a cable company, that a certain fishable area to the west of Ireland in the Atlantic cable zone and including about 2500 square nautical miles, should be proscribed to trawlers by legal enactment. The board did not suport this contention, partly because the closure of one such area would probably lead to the similar closure of various other fishable areas, to the great detriment of the fishing industry; besides which, the proscription could only be enforced by international agreement and much naval police duty.

The board acknowledged, however, the seriousness of the danger to submarine cables, and recommended closer and more harmonious relations between the cable and trawler interests for co-operation toward their mutual protection; also the proper official inspection of the otter-boards of outgoing steam trawlers at each port, and the replacement of lighter by heavier armored cable in fishable waters.

The report of the board seems, on the whole, very reasonable and fair. There is no doubt that the steam trawler is an institution that has come with its mind definitely made up to stay and to fish. There are likely to be more steam trawlers in future, rather than less, and they are likely to increase rather than to contract the zones of their operations. On the other hand, there is nothing except sunken wrecks that a steam trawl captain detests more than a hooked submarine cable, and he is likely to do all in his power to minimize the chance of hooking a cable so long as he is allowed to dredge over the bottom.

The best plan appears to be to improve the designs of otter-boards and to keep them carefully inspected. After that is done, there will still be cases, probably, of cables accidentally caught by trawlers, but these are likely to be less numerous than the cases of cables hooked accidentally by the deep-sea anchors of fishing vessels. Meanwhile it is to be hoped that fishermen can be shipped occasionally on cable vessels and cable men on fishing trips for the better mutual information of each other's ways. The proscription of thousands of square miles of land at the bottom of the sea is not an easy task to agree to internationally, and it would be practically impossible at the present time to enforce, even if agreed to. The distribution of charts among the fishermen showing the locations of the cables would naturally do no harm, but since a large number of that worthy folk never own a sextant and find their way home by compass, lead and special Providence, the information would be of rare avail.

Wisconsin Rate Commission News.

A considerable number of applications for modifications of rule No. 17 of the standards for gas and electric service have been granted by the Wisconsin Rate Commission recently. This rule states that all service meters shall be tested at least once a year; this test to be made at light load, half load and full load, the meter being connected in service. The applications come from the smaller companies who find it either impossible to complete the tests on time or who find it impossible to test the meter while connected in service. The commission in some of the cases has granted the extension of time asked for and in the others has permitted the tests to be made at the station.

The commission has modified rule No. 23, relating to a voltage fluctuation of not more than 6 per cent of the minimum, in the case of the Milwaukee Electric Light & Railway Company. This was done to enable the company to supply a small amount of lighting service from its power mains.

In connection with the cases against the Manitowoc and Hudson Electric Light companies alleging poor service and excessive rates, the engineers of the commission have made inspection tests of the services rendered by those companies. In the case of the former company voltage records were taken at various places in order to show, as nearly as possible, the regulation of the entire system. Ten records were taken, of which none shows a variation of less than 6 per cent of the minimum, the percentages varying all the way from 7½ to 24 per cent.

From tests made upon 28 of the companies' meters, chosen at random, only two were found to be within the requirements of rule No. 15, which states that "no electric meter shall be placed in service or allowed to remain in service which has an error of registration in excess of 4 per cent on light load, half load, or full load." It was found that a large proportion of the meters tested considerably under-registered the power used on light load. The percentage variation varied from 30 per cent slow to 30 per cent fast on light load and only 80 per cent of the meters registered within the 4 per cent limit at full load. This condition of affairs existed notwithstanding the fact that all meters had been tested and adjusted every other year by an employee of the company which built the meters.

The inspection made on the Hudson plant by the engineers of the commission showed that of the six voltage records made to determine the general voltage regulation, none was within the 6 per cent limit, but that the voltage fluctuations ranged f m 7 per cent to 18 per cent.

This condition is partially accounted for by the fact that in one of the two power stations operated by the company where hand regulation had to be employed, there was no ammeter in use in the switchboard. Surprising as this condition of affairs seems to be, the engineers of the commission have found many cases of similar kind in other plants inspected by them.

The tests of the company's meters showed that the company was suffering through slow meters and that there were practically no fast meters. Of the 25 meters tested, 12 were found to meet all requirements—between 96 per cent and 104 per cent of absolute accuracy—and 13 were so far from accuracy as to merit condemnation.

The engineers of the commission spent several days in the city of Appleton making tests and examinations to determine whether or not the electrolytic action caused by the return electric railway currents had materially affected the life of the cast-iron water pipes. These tests, which were made in connection with the Appleton Water Works valuation case, failed to show conclusively that the electrolytic action had damaged the pipes sufficiently to affect their useful life, although a difference of potential of 1.2 volts positive existed between the water main and the rails.

Massachusetts Commission News.

The Massachusetts Gas and Electric Light Commission has issued a decision approving the purchase by the Edison Electric Illuminating Company of Brockton of the Bridgewater Electric Company. The board calls attention to the benefits of the consolidation in relation to the recently completed plant of the Brockton Edison Company at East Bridgewater. The Brockton company is now supplying electricity in Brockton, East Bridgewater, Bridgewater, Stoughton, Whitman, Abington and Rockland, and the plans of distribution include service in Cohasset and Scituate. The board states that "the Bridgewater company charges relatively high prices for its electricity and has never given a day service. With a restricted territory it has had a serious struggle for existence, and has never paid any dividends. By consolidation with the Brockton company its customers will receive at once the benefit of the latter's present prices and service, and the facilities will not be diminished, but increased thereby. Along with these obvious advantages in Bridgewater, it is reasonable to expect that the Brockton company by this extension of its business may improve its station load and incidentally to some extent increase the efficiency and economical operation of the plant."

The board has also approved the petition of the Edison Electric Illuminating Company of Brockton for the right to issue additional stock of the par value of $160,000, at a price of $140 per share, and for the purpose of paying promissory notes purchasing the property of the Stoughton Gas & Electric Company and paying the cost of additions to the company's plant.

Canadian Hydroelectric Commission News.

A new system of accounting for the electrical systems which is intended for the use of the municipalities taking power from the Hydroelectric Commission will be formulated within a short time. The commission at a hearing on Dec. 21 discussed the matter and appointed the following committee: A. C. Neff, representing Guelph; J. W. Scully, of Berlin; F. G. Jewell, of London, and R. R. Sweaney, of Toronto, who will be assisted by the Toronto city accountant and W. S. Andrews, who acts in the same capacity for the commission. A report will be prepared promptly and submitted to the Ontario Railway & Muni-

cipal Board. It was felt that if the municipalities were left to prepare their own system that there would be a lack of uniformity. At the present time the municipalities are required to report to the Ontario Railway Board, and it was thought to be of advantage to have a uniform system of accounting included in the reports to be made by the corporations using electric power to the Railway Board.

Hon. Adam Beck, Minister without portfolio in the Ontario cabinet and chairman of the Hydroelectric Commission, has been nominated and is being strongly urged to enter the contest for the Mayoralty of the city of London, his home city. On nomination day, Dec. 23, Hon. Mr. Beck failed to qualify, thus signifying his intention of not wishing to be again Mayor of London.

New York Public Service Commission News.

The Public Service Commission of the First District of New York has had additional hearings upon the second plan proposed by the reorganization committee of the bondholders of the Third Avenue Railroad Company. In the hearing last week Harry Bronner, of Hallgarten & Company, bankers, representing the bondholders, said that he considered it his duty as a member of the committee to protect to the full extent the principal and interest of the bondholders. Also, that the committee sincerely believed in the future of the Third Avenue company in regard to earnings, and that the junior security holders would reap their reward in the development that would come in the future under the present plan. When asked by Chairman Willcox if the company was able at this time to earn interest on a capitalization of $54,000,000, the amount suggested in the new plan, Mr. Bronner said that he did not think that it was, but that he believed that the possibilities were such that it would be able to earn an assured interest on this amount within a few years. There was a final hearing on this plan Dec. 27, and the decision of the commission is expected within a short time.

Acting upon a communication from the Public Service Commission of the First District, Attorney-General O'Malley has instituted proceedings against certain street railway companies operating in Manhattan for forfeiture of their franchises, on the ground that the companies have abandoned the operation of the lines. This action was taken in the cases of companies which have been simply running a few horse cars in order to hold franchises.

The Coney Island & Brooklyn Railroad Company has asked the Public Service Commission for a rehearing of its application for permission to issue $327,000 in bonds. The commission previously allowed the company to issue $107,000 of bonds. The rehearing was set for Jan. 17.

The Board of Estimate and Apportionment has granted the modified franchise asked for by the South Shore Traction Company to operate a line from the Manhattan end of the Queensboro Bridge to points in Queens County. Right was given to the company by the Board of Estimate about two months ago to use the bridge under an amended franchise granting more liberal terms than the original franchise, but an injunction was granted on the application of a citizen preventing further action in the matter. This injunction was upheld in the Supreme Court, but last week the Appellate Division of the same court reversed the first ruling, leaving the way open for the Board of Estimate to grant the franchise desired.

At the hearing before the commission as to why side-door trains were not operated throughout the day instead of being operated only in the rush hours, Mr. Frank Hedley, general manager of the Interborough Rapid Transit Company, stated that while the operation of these trains saved 20 seconds at each station stop during the rush hours, he considered that it was not necessary to operate them when traffic was light. Trains at this time were upon sufficient headway not to need the saving of time, and he believed that the use of side doors tended to add to the possibility of accidents. He stated that at the present time there were 17 side-door trains in operation, which number was in excess of the original order made by the commission.

The Public Service Commission of the First District has issued a preëmptory order directing the equipment of all the surface cars operated in the congested traffic parts of Brooklyn with wheel guards, as well as protecting fenders. This order is additional to the general order issued last summer upon the same topic.

The Public Service Commission of the Second District has granted permission and approval to the Mineville Light, Heat & Power Company to exercise franchises granted by the town of Moriah to operate in the villages of Mineville and Witherbee and also to issue capital stock to the amount of $10,000, of which $3,634 is to be issued for the purchase price of an electric plant heretofore constructed by the firm of Witherbee, Sherman & Company and the remaining amount to be issued for cash and the proceeds used for extension, improvement and enlarging the plant.

CURRENT NEWS AND NOTES.

WIRELESS TELEGRAPHY.—At a meeting of the Pittsfield Section of the American Institute of Electrical Engineers, held on Dec. 21, Dr. A. E. Kennelly delivered a lecture on "The Mechanism of Wireless Telegraphy."

BONUS FOR EMPLOYEES.—The United States Steel Corporation has offered to distribute to the officers and employees of the corporation and subsidiary corporations a bonus of over $2,000,000. This amount, which is determined by the annual earnings, is being paid 60 per cent in cash and 40 per cent in preferred stock at 124, or common stock at 90, in accordance with the wishes of the recipients.

AUSTRALIAN PATENT LEGISLATION.—The Australian Federation has enacted laws similar to the new patent laws of Great Britain, which have created considerable apprehension in the mother country, it being feared that British manufacturers will have to establish branches in Australia or lose their trade. It has been suggested that a reciprocal arrangement on the subject be made with Great Britain, which would in effect be a trade preference.

ELECTRICAL TRADES SOCIETY OF NEW YORK.—At its fourteenth annual meeting, held on Dec. 14, the Electrical Trades Society of New York elected the following officers: President, Mr. P. M. Haight; vice-president, Mr. W. B. Wallace; treasurer, Mr. W. H. Roberts; secretary, Mr. Frank Neilson. During the fiscal year the society handled about 4000 claims, aggregating more than $250,000, of which 78 per cent was collected through the association's efforts.

THE METRIC SYSTEM IN DENMARK.—The Danish Minister of Commerce has just decided that the metric system alone is to be employed in Denmark on and after April 1, 1910, in all custom houses and in connection with all public taxes. This decision is in conformity with a law voted by the Danish Parliament in 1907, which prescribed the adoption of the metric system in Denmark within three years in all matters pertaining to the operation of the customs and to public taxation. The date fixed for the general application of the metric system in commerce is April 1, 1912.

TELEPHONE IN SNOW STORM.—The New York Telephone Company has called attention to the proved reliability of the service from its underground circuits during the violent snow storm on Dec. 25 and 26, when transportation systems were not in operation and many telegraph lines were out of service. The telephone was found an excellent aid in returning the surface car transportation to its normal condition, more than 300 calls having been made over the telephone by the street cleaning commissioner in arranging for the removal of the snow. Of the telegraph companies, the Postal reported trouble between Hartford and Boston, Lowell and Boston, and Providence and Boston; the Western Union reported trouble also in the Boston neighborhood.

PEAT FOR FUEL.—Experiments relating to the use of peat for fuel are to be conducted on a large scale at Lynnfield Center, Mass., where the Saugus River Peat Company owns extensive peat bogs and hopes to be able to produce electricity at a low cost.

A B C OF TALKING OVER THE TELEPHONE.—Some of the telephone users of Chicago are placing on their telephone transmitters a little circular disk of celluloid bearing the words "Accuracy, Brevity, Courtesy." This is said to be the A B C of the use of the telephone.

RUSSIAN ELECTRIC STEEL MILL.—The Russian crown steel works at Slatons, in the Ural district, have secured the right to manufacture steel electrically by a process owned by a German company by making use of induction furnaces. An electric plant will be immediately installed by the Siemens-Halske Company, and the product is expected to be marketed within a short time.

WIRELESS TELEGRAPHY.—Of 282 steamships that carried steerage passengers to and from the United States during the first half of 1909, 143 were equipped with wireless telegraph apparatus. Of the 167 prominent coastwise vessels 97 are provided with wireless equipments. Secretary Nagel has recommended the passage of a bill requiring wireless installations on passenger steamers carrying more than a certain number of passengers over more than a given distance.

BALTIMORE ELECTRICAL INSPECTORS REDUCED.—As a result of the Budget which was recently made up in Baltimore, nearly all of the appropriations which were asked for by the various city departments were cut down. In the Building Inspector's office it was necessary to reduce the number of electrical inspectors in order that the salary list might not exceed the amount authorized for expenditure in that department.

OMISSION.—In an article by Mr. Einar A. Brofos, entitled "Norwegian 250,000-hp Hydroelectric Development," which appeared in our issue for Dec. 9, credit should have been given to the Allmänna Svenska Elektriska Aktiebolaget, of Westeras, Sweden, for supplying five of the 11,000-volt generators, the order for the 10 generators having been divided equally between this firm and Brown, Boveri & Company, of Baden, Switzerland.

AN ELECTRICAL ENGINEERING FRATERNITY.—A chapter of Eta Kappa Nu was installed Dec. 4 at Pennsylvania State College, State College, Pa. Eta Kappa Nu is a semi-honorary fraternity of electrical engineering students, which was founded at the University of Illinois in 1904. Its chapter roll now include Illinois, Ohio State, Armour Institute and Pennsylvania State, with alumni chapters at Chicago and Pittsburgh. The object of the association is to bring together the better students in all of the engineering schools of the country.

CORNELL GRADUATE SCHOOL.—The seventeenth annual report of President Schuman calls attention to the recently established Graduate School at Cornell University. The faculty of this school consists of those professors and assistant professors who are actively engaged in supervising the work of graduate students as members of the special committees in charge of major and minor subjects. During the past year there were enrolled in this school 310 students, 34 of whom received the degree of Doctor of Philosophy. The dean of this school is Prof. Ernest Merritt, of the Department of Physics.

OVERHEAD WIRES DOWN AGAIN IN BALTIMORE.—The heavy snow in Baltimore on Christmas day wrought havoc with the few remaining overhead wires in that city, and recalled the conditions of last March. The heavy wires of the United Railways Company were fortunately strong enough to stand the weight of the snow, but the broken telephone and electric light wires caused considerable inconvenience. The Postal-Telegraph Company had some trouble early in the evening in getting its New York lines in operation; the Western Union experienced difficulty with its minor lines, but the main lines were all in good working order. In the northwestern section of the city the wires were down, but the lines that were everywhere most affected by the storm were those leading to fire alarm and patrol boxes. Police calls in some districts were made under extreme difficulty and the Fire Department kept a close watch on its boxes to be sure that they were in good condition.

SIMON NEWCOMB'S DEFINITION OF THE MAGNET.—A writer in the *North American Review* who came into contact with the late Prof. Simon Newcomb in work connected with the compilation of the Standard Dictionary, relates the following anecdote referring to the great astronomer: Newcomb, who had general oversight of definitions in physical science, on one occasion came into the office greatly dissatisfied with the definition that had been framed for the word "magnet." The definition simply enumerated the properties of the thing, a course which in the absence of authoritative knowledge of their causes was thought to be the only rational procedure. But Newcomb's mind demanded a logical treatment, and, though he must have seen from the outset that this was a forlorn hope, his tenacity of purpose kept him, pencil in hand, writing and erasing alternately for an hour or more. Finally he confessed that he could do no better than the following pair of definitions: "Magnet, a body capable of exerting magnetic force," and "Magnetic force, the force exerted by a magnet." With a hearty laugh at his effort he threw down his pencil, and the imperfect and illogical office definition was accepted.

RIGHT TO FIX RETAIL PRICE OF PATENTED ARTICLE.—The United States District Court of the Southern District of New York, by the issue of an injunction, has sustained the right of the owner of a patent to fix the retail price of an article covered by said patent, and to require that all reasonable and proper conditions imposed as to the sale of such articles shall be maintained. The suit related to the sale of the Klaxon automobile horn, the charge being that the defendant had violated the terms of the license accorded him for selling the device by offering it at a price less than that fixed, by erasing the special serial number given to each horn, and by detaching prior to sale the license tag secured to the horn by a wire fastened by a lead seal. The injunction issued enjoined the defendant from selling the Klaxon horn at a price less than that fixed by the sales agreement, prohibited the license tags to be detached, altered or erased, or any of the marks, notices, license tag or labels being concealed in the case of any horn or any box containing one or more horns, and specifically prohibiting the erasure or rendering illegible the serial number stamped upon the name plate of a horn.

EXTENSION OF WIRELESS IN NAVY.—According to plans formulated by Rear-Admiral Cowles, chief of the Bureau of Equipment of the U. S. Navy, and submitted by him to Congress, wireless apparatus of the latest type is to be supplied to all the new vessels of the navy, including destroyers and all auxiliaries, as this latter class of vessel has proved very valuable in establishing wireless chains across long stretches of ocean without the necessity of disrupting the fighting fleet. Another shore station is contemplated at Dutch Harbor, Alaska, to carry wireless to Bering Sea, connecting with the Cape Nome station, permitting vessels from Nome to Lower California to keep in touch with the world. After the contemplated high-powered station in Washington has been completed it is believed a similar station will be found necessary in the following localities: The west coast of the United States, the Panama Canal Zone, Hawaii and the Philippines. With stations of such power at these places vessels will be within call while going to or from or while in practically all waters where naval operations of interest to the United States might be expected. Each station will cost $100,000.

Generating Station of the Lehigh Coal & Navigation Company.

THE Lehigh Coal & Navigation Company owns extensive anthracite coal properties extending from Mauch Chunk to Tamaqua, Pa. It also owns the canal paralleling the Lehigh River from Coalport to Easton, 48 miles, and leases the Delaware Division Canal, 60 miles. In addition, the company owns, controls and leases many steam railroads, chiefly freight roads, operating in or near its domains. For the purpose of supplying electricity to its many mines for haulage, pumping and lighting, the company, a few years ago, erected a large power house in the valley at Lansford, Pa. Besides supplying the mines the station feeds the circuits of the Panther Valley Electric Light, Heat & Power Company and the railway lines of the Eastern Pennsylvania Railways Company operating between Mauch Chunk, Lansford, Summit Hill, Nesquehoning and Tamaqua. The Panther Valley Electric Light, Heat & Power Company owns the lighting circuits in Lansford, Summit Hill, Coaldale and Nesquehoning. The Lehigh Coal & Navigation Company's canal is also the source of power for several electrical generating stations, notably those at Mauch Chunk, Easton and Raubsville, Pa., the electric generating companies at these towns leasing the water rights.

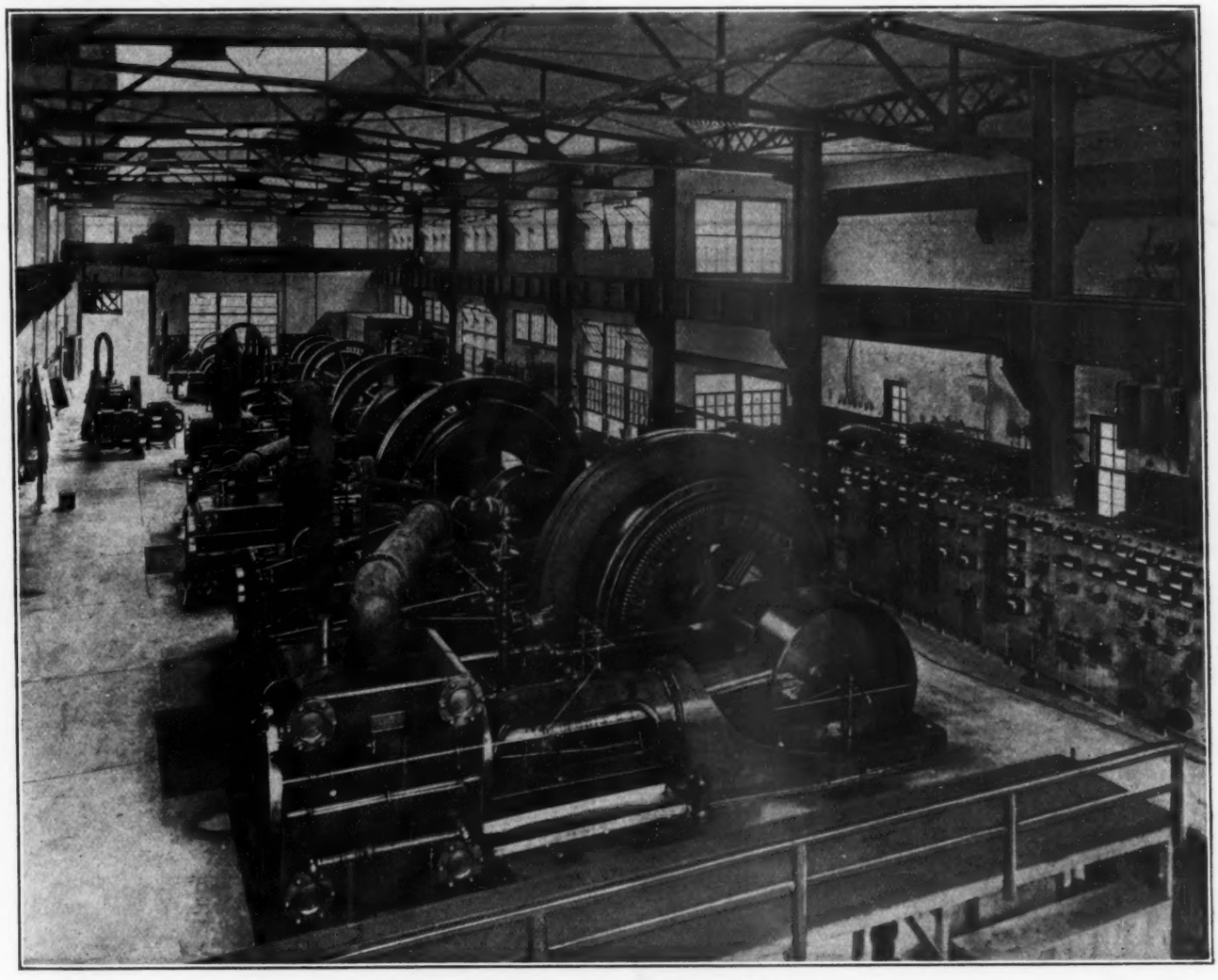


FIG. 1.—GENERATOR ROOM OF LEHIGH COAL & NAVIGATION COMPANY'S POWER STATION.

A general view of the generator room of the station at Lansford is shown in Fig. 1. The equipment consists of one 700-kw and one 400-kw, 25-cycle, 2300-volt, three-phase Westinghouse alternators, direct-connected to Allis-Chalmers cross-compound engines; one 200-kw, 60-cycle, 1100-volt, two-phase Crocker-Wheeler alternator, direct-connected to a Ball engine; and one 2300-volt, three-phase motor direct-connected to a 150-light Brush arc machine. These units were installed new, while the following equipment was moved from the old power station which had been furnishing energy to the Tamaqua & Lansford Railway Company and the Panther Valley Electric Light, Heat & Power Company for about 12 years; one 425-kw, 600-volt General Electric generator, direct-connected to a Wetherill simple Corliss engine; two 225-kw, 600-volt Walker generators direct-connected to Lane & Bodley simple Corliss engines; one 120-kw, 1100-volt, two-phase, 60-cycle generator belted to a Fischer enclosed-type engine, and one 75-light Wood arc machine belted to a Ball engine.

The boiler-room contains six 300-hp and three 500-hp Maxim water-tube boilers, fitted with flat stationary grates having 12 per cent air space, and equipped with Eynon & Evans and Parsons blowers, both under the grates and in the stacks. Buckwheat No. 3, washed from the company's own mines, is used under the boilers, and although fan blowers with exhaust steam might show a trifle better efficiency, with the class of labor and fuel used, steam jet blowers are found to answer best. An automatic pressure regulator is used in connection with the steam blowers so that a fairly constant steam pressure is maintained at all times.

The steam piping and heaters as originally laid out were found to be wanting in flexibility and at the present time the piping and feed-water systems are being redesigned. A Link Belt pan ash conveyor is also being installed beneath the boiler-room floor in a tunnel passing in front of the boilers. This conveyor will take the ashes the length of the boiler room and

then elevate them sufficiently to permit them to flow by gravity into railroad cars, whence they will be removed for track and other work.

There are three separate switchboards provided in the generator room, one for the mines, shops and storage yards, one for the circuits of the Eastern Pennsylvania Railways Company and the third for the circuits of the Panther Valley Electric Light, Heat & Power Company. These are all of standard design and are shown in the engravings. As there is a very bad load factor on the three simple Corliss engines feeding the trolley system and the two cross-compound mine engines, a 300-kw rotary-converter has been arranged so as to be used as a compound-wound rotary, an inverted compound-wound rotary or as a shunt-wound rotary, balancing the load on the alternating and direct-current generators. It is used as the latter almost altogether and has permitted the shutting down of the 400-kw alternator the greater part of the time.

The load fed from the station consists of four 20-ton, two 15-ton and 31 8.5-ton electric mine locomotives located 100 ft. to 1200 ft. below the surface; 300 hp in lamp and motor equipment in machine, boiler, car and carpenter shops and a briquetting plant; 525 hp in motors at a 150,000-ton storage plant; from 7 to 20 trolley cars equipped with four 50-hp motors; 250 kw in commercial arcs and incandescent lamps and 150 direct-current, series-arc lamps.

The mine locomotives are fed from five substations; three rated at 300 kw, one at 600 kw and one at 150 kw. Two of these substations are fed from 2300-volt, three-phase feeders and transform to 300 volts direct-current. Two are fed with 10,000-volt, three-phase current and supply direct-current at 300 volts. The fifth substation is supplied from 10,000-volt, three-phase circuits and has an output of 300 kw in 600-volt

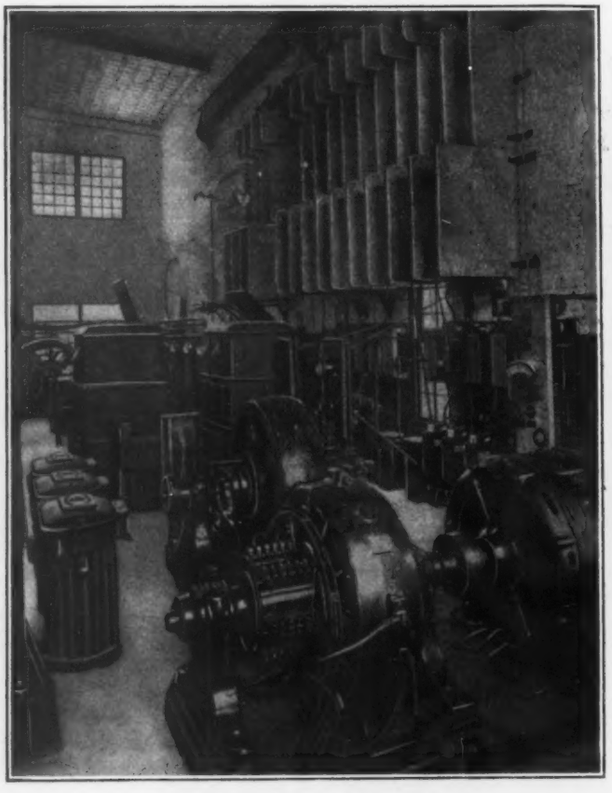


FIG 2.—VIEW OF TRANSFORMING EQUIPMENT.

direct-current and 300-kw, 300-volt direct-curent; the former for the trolley system and the latter for the mines. The station supplies a territory 15 miles long and 6 miles broad and is already loaded to its full economical capacity. Plans are prepared for the installation of 600 kw additional equipment early next year.

There are some features of operation which are worthy of note. At a substation in Nesquehoning there is a six-phase rotary which is started from the alternating-current side in such a way that the starting current is quite small. Three single-phase, 110-kw transformers, having 50 per cent and 25

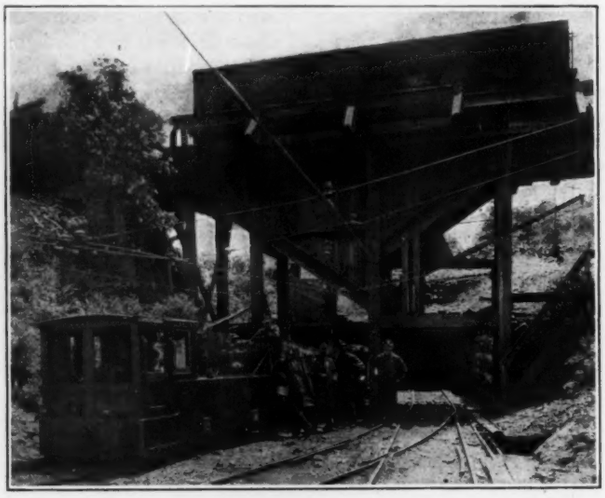


FIG. 3.—ELECTRIC LOCOMOTIVE AT MOUTH OF NO. 5 TUNNEL.

per cent taps brought out from the secondary, are employed for this purpose. The 50 per cent taps of the three transformers are connected together and the 25 per cent taps are brought to the top points of a three-pole, double-throw switch and three to the bottom of a three-pole, single-throw switch. The method of starting is as follows: The 25 per cent taps are first connected to the rotary, then the ends having the same phase relation and finally the three leads 30 deg. apart from these.

At the storage yard, trouble was experienced because it was

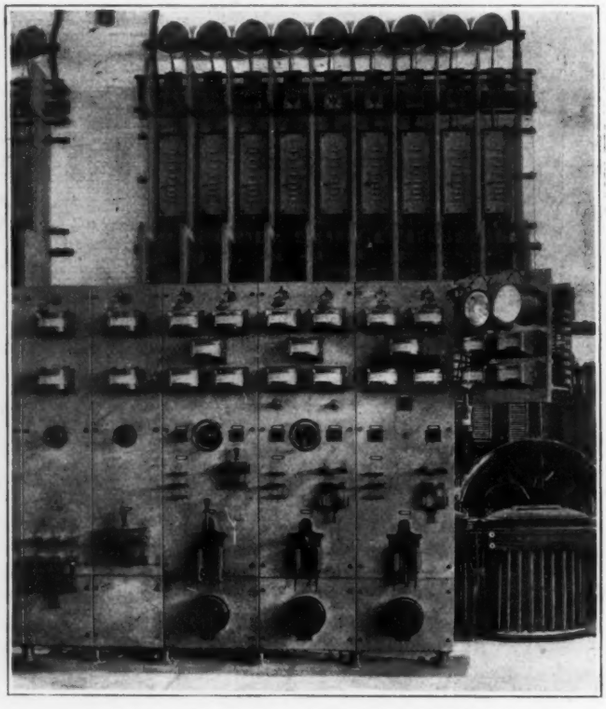


FIG. 4.—ONE END OF MINING SWITCHBOARD.

not possible to shut down motors quick enough in case of accident. The electrical engineer of the company, Mr. J. F. MacWilliams, designed a circuit-breaker which has worked satisfactorily for this purpose. The motors are operated at 440 volts and the circuit-breaker on each motor is fitted with a trip coil wound for 120 volts. The energy for operating these trip coils

is brought from transformers connected on the main line and 25-amp switches are placed at every point where men are at work. These switches not only open the circuit-breaker, but also lock it open by an electro-mechanical device so that the circuit-breaker cannot be closed until the switch is opened at

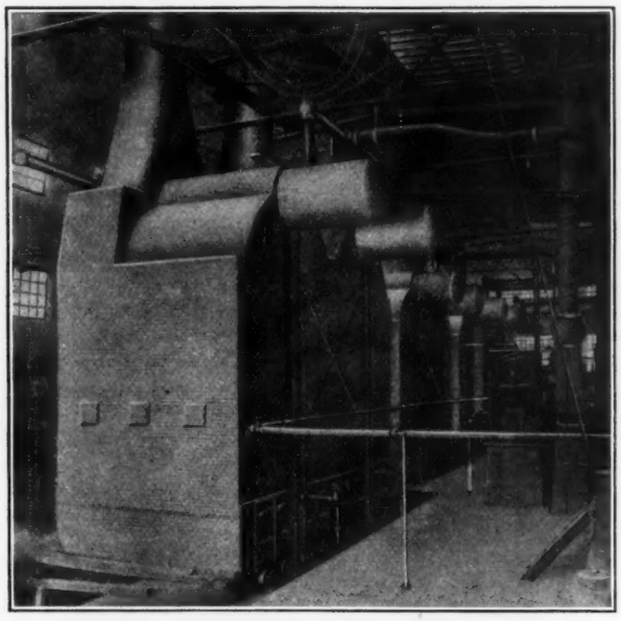


FIG. 5.—GENERAL VIEW OF BOILER-ROOM.

the point of trouble. This tripping and locking device is also arranged as a fool-proof starter. Since there are 12 circuit-breakers, one main switch and one short-circuiting switch used in starting, any one switch thrown the wrong way opens the circuit-breakers so that the motor cannot be thrown into circuit.

In the mines trolley hangers and bonds differing somewhat from those used in other mines are employed. Owing to the great pitch in the coal veins, the hauls are long and the track must be changed from time to time so that a flexible bond on the tracks is not of much use. The pipe hangers employed are 1½ in. in diameter and the bonds are made with a pin having a slight taper. At the end opposite the head, a lock washer and nut are fitted and scrap copper is soldered in the head of the pin. Bonds of this type are readily removable and have given excellent service. The generating station was designed by Messrs. Dodge & Day, of Philadelphia.

Gas-Producer Central Station at Aberdeen, South Dakota.

ALMOST interesting central station using gas producers and gas engines as a source of power is that of the Aberdeen Light & Power Company, at Aberdeen, S. D. This company has been operating a producer gas plant since April, 1908, and the growth of its station has been rapid. Aberdeen is a city of about 10,000 population, the electric lighting history of which is very different from that of most Western towns. As a general rule, electric lighting throughout the West is used almost exclusively where such service is available, and gas, if used at all, is confined to cooking. In Aberdeen, however, gas lighting was used almost exclusively up to the spring of 1908, when the Aberdeen Light & Power Company began operations. There was a small central station in the town, but owing to unsatisfactory service and franchise troubles, no electric service whatever had been given for the year previous to the starting of the new plant.

The present gas-engine plant started in May, 1908, with a peak load of about 47 kva. By October, 1909, the peak as measured by the maximum hourly output shown by the watt-hour meters was 470 kw. The growth of the company's output and peak load is shown by Fig. 1. The dotted portions of the curves are for intervals where the records are incomplete, due to switchboard alterations, meter calibration, etc.

The equipment now consists of four Muenzel gas producers made by the Minneapolis Steel & Machinery Company, rated at

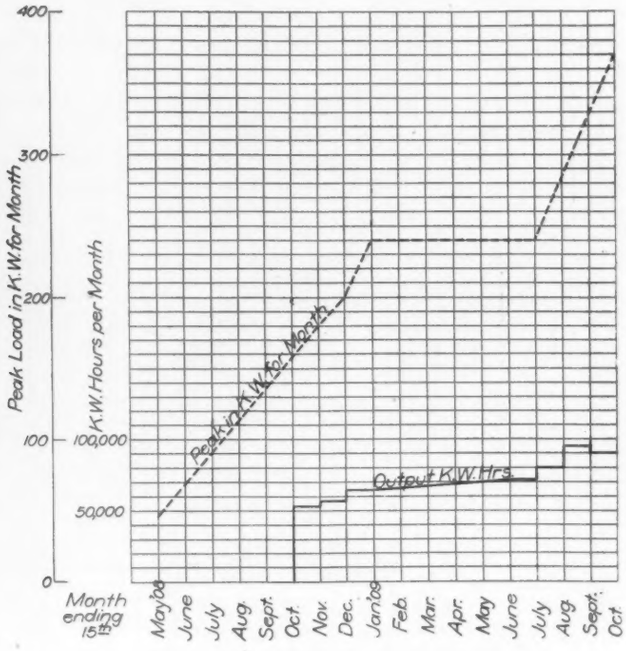


FIG. 1.—GROWTH OF OUTPUT AND PEAK, ABERDEEN, S. D.

150 hp each, and two twin Muenzel gas engines rated at 350 hp each and running at 190 r.p.m. One of these engines has cylinders 20¾-in. x 32-in. stroke, and the other 21-in. x 32-in. stroke. Fig. 2 shows a rather unsatisfactory view of half of each of these units. Each consists in reality of two single-cylinder engines connected to the same shaft and flywheel. Each engine is belted by a 23-in. belt to a 250-kw, three-phase, 60-cycle, 2300-volt generator made by the Electric Machinery Company, of Minneapolis. A 200-hp engine, 18¾-in. x 28-in. stroke, is being installed in an addition to the building. This is for the purpose of increasing the capacity and adjusting the engines in service more accurately to the loads.

The power-house building is of concrete blocks, 8 in. thick, reinforced with a layer of brick inside the concrete. The re-

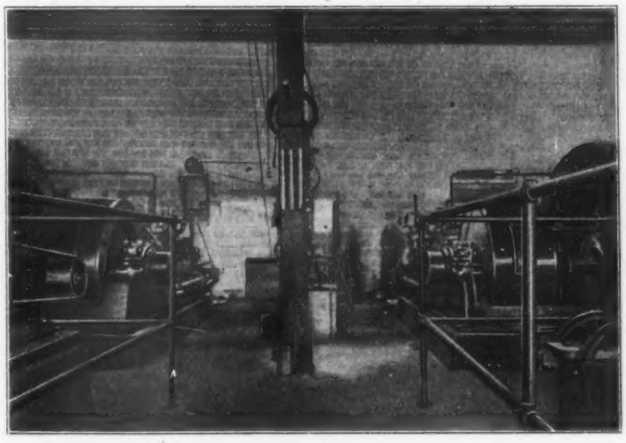


FIG. 2.—ENGINE ROOM, ABERDEEN, S. D.

cent addition, however, has concrete reinforcement inside of the concrete blocks, in place of the brick. The output is measured by watt-hour meters. Two air tanks, 30 in. x 72 in., built for a working pressure of 130 lb. per square inch, store air for starting the engines. In the center of the plant, behind the pillar seen in the center of Fig. 2, is a short lineshaft which

can be driven either by an electric motor or small gasoline engine. This lineshaft drives a compressor supplying the compressed-air starting tanks.

Fig. 3 shows a plan view of the plant, exclusive of the recent addition to the engine-room, and Fig. 4 gives a sectional elevation. The rear of the building in which the producers are

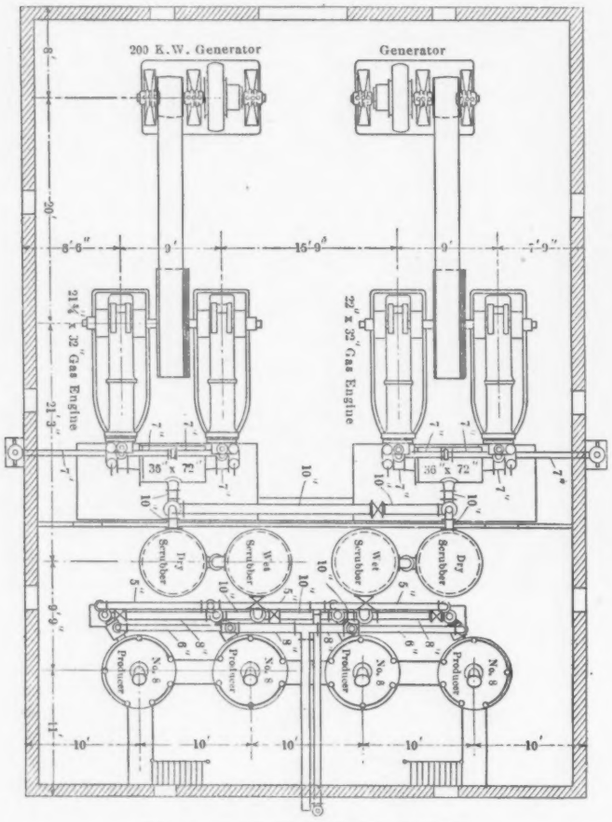


FIG. 3.—PLAN OF ABERDEEN STATION.

located faces a railroad siding, from which coal is unloaded by means of an elevator. The coal used is Pennsylvania anthracite. It is unloaded from cars through a chute which delivers the coal into a hopper from which it is taken by a motor-driven bucket conveyor into a hopper in the upper part of the elevator, whence it is drawn as occasion requires into a movable hopper for charging the producers. Below the upper hopper in the elevator is a bin for the storage of extra coal. The storage part of this coal elevator is made of 2 x 4 timbers laid flatwise to give strength.

Fig. 5 is a view in the gas-producer room showing three of

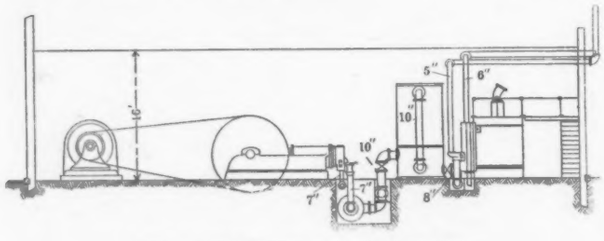


FIG. 4.—ELEVATION OF POWER PLANT.

the producers, and the movable hopper for charging the producers with coal. This movable hopper is suspended from an overhead tramway, and when filled with coal from the storage hopper in the top of the elevator, is run to the various producers. As shown in Fig. 3, all four of the producers are piped to a common header. From this header the gas is taken first through the wet scrubbers and then through dry scrubbers to the main header in the engine-room. There are two sets of scrubbers. By operating all four producers on one header, the gas supplied to the engines is more uniform and the poking and cleaning of fires are not so likely to interfere with the operation of the engines by altering the quality of the gas. On each dry scrubber is an asbestos-packed relief valve, consisting simply of a disk packed with asbestos and resting on a circular opening. This relief valve opens automatically in case explosions in the

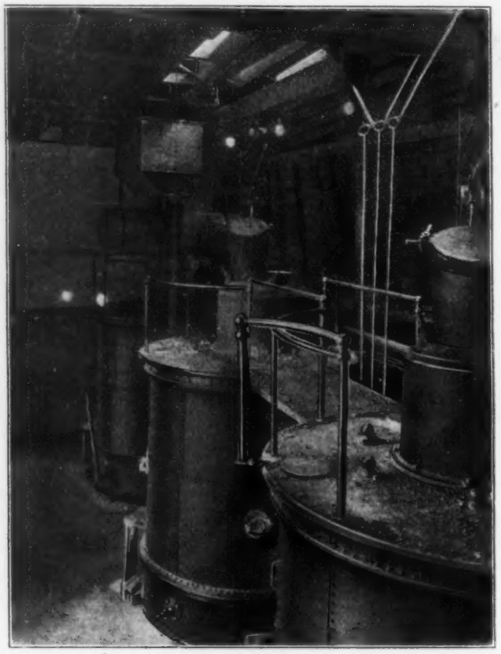


FIG. 5.—GAS PRODUCERS, ABERDEEN, S. D.

engine cylinders, during suction stroke, cause abnormal pressure on the scrubber.

Gas check valves are installed between each engine and the main header to prevent air from getting into the main gas header by any possible manipulation of an idle engine and thus interfere with the operation of another engine on the header. As a matter of fact, these check valves at the time of the writer's visit to the plant had been broken by back-firing of the engines, so that both engines were being operated off the header, without the check valves. As long as due care is used in the operation, this plan works well, but the check valves are a good safety precaution, because there is a constant suction on the main gas header and air will rush into it whenever it has a chance. The first producer, which started in May, 1908, was operated continuously without being shut down, until the writer visited the plant in October, 1909.

Coal costs about $7 per ton, and the producers are operated on a regular routine of shaking, poking and stoking, every two hours. Only one producer is stoked at a time, so that the change in the condition of the fire takes place in only one of the three producers at a time. This minimizes any change in the quality of the gas due to fixing the fires. Once a day the ashes on each producer are cleaned out, both from above and below the grates. For cleaning out above the grates, a poker with a short hook on the end is used. The operator first carefully hooks out a layer of ashes and small clinkers from around the outer portions of the grate. There are doors on opposite sides of the producer, so that half of the fire can be cleaned from each side. After the ashes are pulled out from under the outer edges, those in the center are pulled out and the fire falls down 2 in. or 3 in. Ashes are taken from under the grates at the same time.

The cleanliness of the producer room is greatly improved by piping water to each ash-pit door. A fine spray of water is kept running from the top of the ash-pit door during the time that ashes are being cleaned out, and water is also admitted to the ash pit to sprinkle the ashes as fast as they are pulled out from on top of the grate, and it keeps those falling through

the grate wet. This makes it both pleasanter for the operator and better for the general cleanliness of the plant. Much depends on careful and thorough cleaning of ashes from over the grates, so that clinkers are not allowed to accumulate. There is, however, little trouble with large clinkers.

The only troubles that have been experienced with the producer end of the plant occurred at a time when there was a delay about getting the regular pea coal. To tide over, some chestnut anthracite was secured from local dealers. The chestnut worked well, but when the process of changing back to the pea size began, there was much trouble. The chestnut coal in the bottom of the producer seemed to admit too much air to the fine coal in the top if the fires were worked hard enough to keep the coarse coal burning in the bottom. The result was that the fires got very high, making the producers hard to handle because of the heat around the top. The situation was not relieved any by the fact that it was the hottest weather of the year.

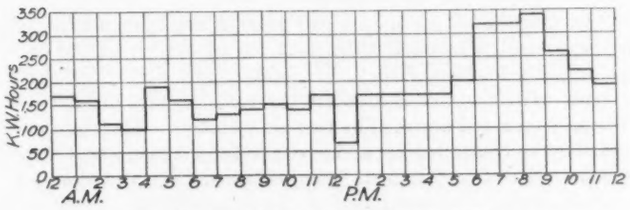


FIG. 6.—ABERDEEN LOAD, OCT. 14, 1909.

For the operation of the plant 24 hours, six men are required. These men work in three shifts of 10 hours each, so that portions of the day the shifts overlap. The daily load curve of the plant for Oct. 14, 1909, is shown in Fig. 6. This is taken from the hourly readings of the watt-hour meters at the switchboard. Section gages are placed at four points between the producers and the engines, as follows: One at the producer outlet, two at the wet-scrubber outlet, three at the dry-scrubber outlet and four at the engine. These section gages have oil columns instead of water, on account of the more rapid evaporation of water. The suction on the engine gages is kept at from 3½ in. to 6 in., according to the load.

It is not feasible to carry a load of over 400 kw on the two 250-kw units with the four 150-hp producers in operation. The full 250-kw rated load of one engine unit can be carried with the three producers supplying the engine. The engine capacity of the plant is, therefore, in excess of the producer capacity. The accompanying table shows the coal consumed per kw-hour for eight different periods since the plant started operation. From this it is seen that the coal consumption, which was 2.1 lb. per kw-hour for the first period for which records are obtainable, was reduced to 1.5 lb. in the fall of 1909. The chief engineer of this plant is Mr. R. D. Parks, a man of much experience in gas-engine producer work, having been connected with gas-producer manufacture before going to Aberdeen. The president and manager of the Aberdeen Light & Power Company is Mr. A. H. Pease, and the electrical engineer Mr. J. D. Gibbs.

A number of other producer gas-engine central stations have been installed in some of the smaller towns of South Dakota. These plants are partially owned by the same interests that control the Aberdeen plant. At Wagner, S. D., there is an 80-hp and a 45-hp engine with two Muenzel producers. This plant has been in operation since 1907. At Armour, S. D., a 100-hp Muenzel engine and producer have been in operation since December, 1907. At Platt, S. D., there is a 85-hp engine and a Muenzel producer. At Geddes there is one three-cylinder vertical Fairbanks-Morse producer. There are now being installed one 35-hp and one 40-hp Muenzel engine. At Scotland, S. D., an 85-hp Muenzel engine and producer are being installed. At Platt, S. D., the consumption of coal is from 1.25 lb. to 1.5 lb. per hp-hour. The service in these small plants is stated by Mr. Parks to be very reliable, as they operate only at night, and during the day small repairs on engines may be made.

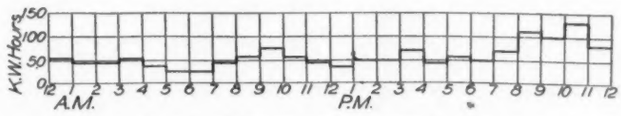


FIG. 7.—ABERDEEN LOAD, JUNE 8, 1909.

COAL CONSUMPTION—ABERDEEN (S. D.) PRODUCER GAS PLANT.

	Kw-hours	Lbs. coal	Lbs. per Kw-hour.
Oct. 15 to Nov. 15, 1908	56,820	118,430	2.1
Nov. 15 to Dec. 15, 1908	58,260	129,080	2.2
Dec. 15, 1908, to Jan. 15, 1909	64,840	145,430	2.2
Jan. 15 to Feb. 1, 1909	31,790	69,600	2.1
June 15 to July 15, 1909	77,530	184,800	2.1
July 15 to Aug. 15, 1909	88,474	167,500	1.9
Aug. 15 to Sept. 15, 1909	95,090	167,400	1.8
Sept. 15 to Oct. 15, 1909	110,780	176,000	1.5

Most of the troubles experienced at Aberdeen have been due to engine details. The operation at Aberdeen has on the whole been reliable, considering the fact that the load has been growing so fast, and that the entire plant has to be operated during the heavy-load hours of each day, thus leaving no reserve capacity.

The rapid growth of the Aberdeen load, as shown by Fig. 1, is a powerful illustration of the fact that people in a progressive Western town are eager for electric service, if only good service is offered. The daily load curves, Figs. 6 and 7, show that a considerable motor load has been picked up in the short time the plant has been operating. This motor load has made it necessary to operate both engine units much of the day in order to take care of the sudden fluctuations which sometimes occur.

Multiple Unit Circuits for Single-Phase Trains.

BY RALPH W. KRASS.

IN view of the scarcity of general information concerning the details of the multiple-unit control equipments used with single-phase trains, it is believed that a description of the operating features of an installation that has been in successful use in trunk-line service for the past three years will prove of interest at this time.

On each of the motor-cars of this equipment there are three distinct circuits, namely, the high-potential, the low-potential and the control.

HIGH-POTENTIAL CIRCUITS.

The alternating current is taken from the trolley wire at 11,000 volts potential by means of a pantograph. From the pantograph trolley it passes down the side of the car (through the lorricated conduit) and on to the line switch. From the line switch the current passes through the high-tension winding of the transformer.

PANTOGRAPH TROLLEY.

The pantograph trolley consists of a light collapsible pantograph of steel tubing supporting a copper shoe, which slides along under the trolley wire. It is raised by springs and lowered by air cylinders. The supply of air to these cylinders is controlled by small magnet valves ("Trolley Up" and Trolley Down").

When it is desirable to lower the trolley shoe, the coil of the "Trolley Down" magnet is energized, thus allowing air to pass into the main cylinder and lower the trolley. The trolley is forced downward until a spring latch on the under side of the shoe engages with a pin of the latch cylinder. The air is then released from the main cylinder and the trolley held down.

TROLLEY UP.

The trolley shoe is raised by energizing the "Trolley Up" coil, which allows air to flow into the latch cylinder and release the shoe by pushing out the pin.

LINE SWITCH.

The line switch is used for the purpose of breaking the high-potential circuit. It is a pneumatically operated oil switch with

an overload release. The circuit is broken under oil. The line switch can be operated from the controller by inserting a plug switch into the controller, and also by means of a handle, which can be reached through a hole in the floor of the car.

AUTO-TRANSFORMER.

The purpose of the auto-transformer as used on single-phase

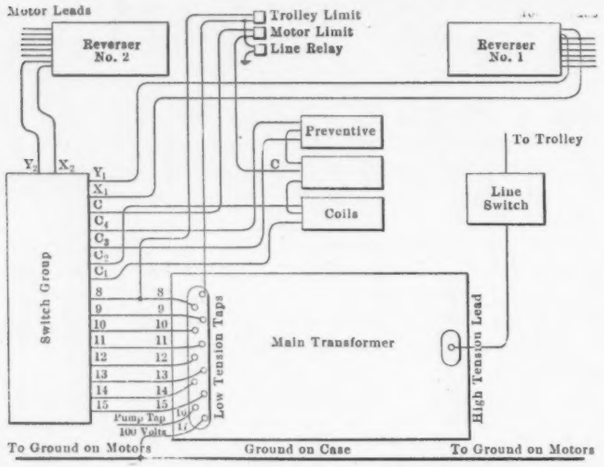


FIG. 1.—ARRANGEMENT OF MAIN WIRING AND APPARATUS.

multiple-unit trains is to reduce the e.m.f. from the high value at the trolley wire to a low value to be applied at the motors. The transformer is of the single-coil type, oil insulated and self-cooling. There are three high-potential taps on the transformer so as to allow for adjustment to line voltage. There are eight low-potential taps, the highest of which gives about 300 volts at the motors. A single tap (100 volts) provides the required voltage for heating, lighting and auxiliary motors.

LOW-POTENTIAL CIRCUITS.

The current passes from the low-potential taps on the transformer (Fig. 1) successively through the switch group, the "preventive" coils, the reversers, motors, to the truck, and then back to the grounded end of the transformer (through ground wire).

SWITCH GROUP.

The switch group consists of a number of independent switches, grouped together and operated by means of small cylinders controlled by electromagnetic valves. The switch group used on these cars is of the standard pneumatically operated type, as is used in connection with multiple-unit control systems. The valve magnets are energized by current obtained from the control circuit at 12 volts. The piston is lifted, air is allowed to enter, the switches forced up and the various contacts thereby made. Thus the closing of the various switches results in introducing various transformer taps into the circuit and thereby varying the voltage impressed on the motors. The normal position of the switches is open, and the failure of the air supply or the interruption of the control circuit opens all of the unit switches.

In changing the voltage applied to the motors by means of the switch group, it is essential not to interrupt the current. This means that the next voltage switch must be closed before the last previous voltage switch is opened. To prevent excessive currents at this instant use is made of "preventive coils" connected across the switches of the switch group. These coils are simply auto-transformers placed in the circuit to prevent the burning out of short-circuited transformer coils during the process of "notching up" for higher speeds. The action of the preventive coils can be explained readily by referring to the diagram of connections shown in Fig. 2. The first position on the transformer is 1-2-3-4, thus requiring the controller to be moved four points to give the first position on the transformer—that is, for the lowest speed. To obtain the next highest speed, coil 1-2 is cut out of the circuit and coil 4-5 is placed into the circuit. Thus, while passing to the second position the coil 1-2 is short-circuited through the preventive coil, which because of its high inductance allows only a small current to pass through the transformer coil, and thereby prevents it from being burned out.

From the diagram it is seen that three such coils are essential in this particular instance, so that for all the running positions on the switch group each of the transformer coils is short-circuited through an inductance during the process of "notching up."

REVERSER.

The function of the reverser as used in any system of automatic control is to govern the direction of motion of the cars by properly interconnecting the armature and field circuit terminals. The reverser is a switch the movable part of which is mounted on a rod actuated by two air cylinders. Each of these cylinders is controlled by a separate valve magnet, the energy for the coils of the magnets being obtained from the auxiliary control circuit. The connections are so arranged that only one coil can be energized at a time, the valve magnets being energized alternately, depending upon the direction in which it is desired to turn the switch. The wires from the armature and field circuit terminals lead to contact fingers which press against metallic strips mounted upon the movable part of the reverser. The arrangement of the fingers relative to the contract strips is such that the current will be made to flow in reverse direction through the armature when the reverser is thrown from one extreme position to the other. There is also a connection from the switch group to each reverser (two wires), which serves to interlock the motion of the reverser with switches of the switch group. Two reversers are used on each car, so that it is possible to control the car from either end.

CONTROL CIRCUITS.

The control circuits consist of wires by means of which current from a small storage battery is made to operate the magnet valves controlling the air on all of the various switches and pieces of apparatus. These currents are governed by the master controller.

BATTERY CONTROL APPARATUS,

All of the magnet valves in the car are operated by current

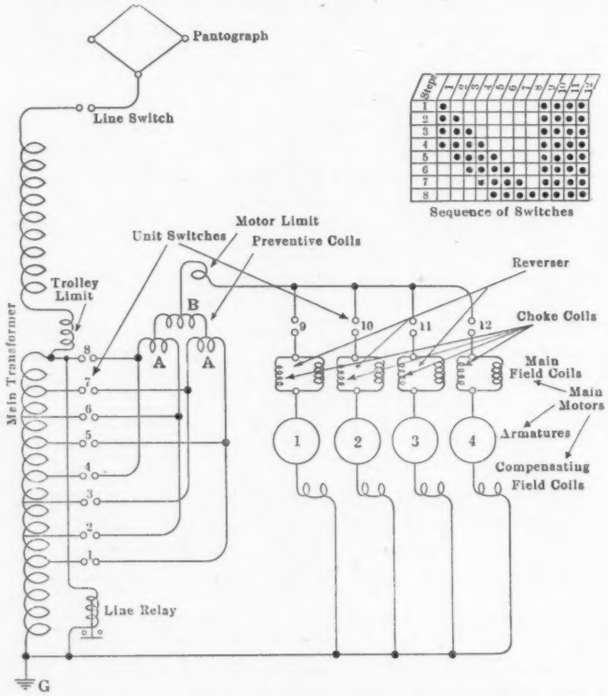


FIG. 2.—SCHEMATIC DIAGRAM OF QUADRUPLE EQUIPMENT OF SINGLE-PHASE SYSTEM.

obtained from a 12-volt storage battery set. There are several reasons for using battery control rather than alternating current control: (1) The circuit is no more complicated with direct current than with alternating current. (2) An alternating current valve magnet is less economical than a direct current valve magnet on account of special features of design necessitated by

the use of alternating current. (3) With alternating current the men are more afraid to handle the control apparatus, although voltage is not sufficiently high to do harm. (4) With alternating current control it is necessary to have the main auto-transformer in circuit while testing the apparatus. (5) The motorman loses entire control of his train in case the line voltage and brakes fail when alternating current control is used.

The storage battery is a very small one, capable of handling the car for only a short time, and must be frequently charged by the motor-generator.

MOTOR-GENERATOR.

The motor-generator consists of a single-phase motor directly connected to a shunt-wound, direct-current generator. It is self-starting, and the circuit is so arranged that the "set" is running all the time the car is in operation. The motor-generator is connected in parallel with the battery through a plug on the master controller, so that when the plug is out it is disconnected on the direct-current side and the battery is prevented from running the motor when no energy is being supplied through the trolley.

CONTROLLER.

The master controller of this equipment is somewhat larger than is usually found on multiple-unit trains, on account of the fact that it contains many switches and other devices which constitute separate parts in other equipments. It is of importance to note that the master controller is of what is known as the "dead man's type"—that is, it is so arranged that if for any reason the handle is moved to the middle position while the train is in motion the current is immediately taken from the motors and the air brakes are automatically applied as for emergency service.

In connection with the controller use is made of a removable handle to which is chained a switch plug used to reset the line switch when it has been opened by an overload trip. Resetting is accomplished by momentarily inserting the plug while the controller handle is in the off position. There are operating receptacles having three positions, the first of which makes contact to close the line switch only, the second makes contact for the master controller operated without the line switch being closed, and the third, on operating position for making contact for the operation of the line switch and controller together. There is a push-button for giving extra high speed and one for unlocking and lowering the trolley. There is an outlet for a 12-conductor train-line cable and an outlet for cables joined to the emergency brake relay valve magnets. There are two such controllers on each car, thus permitting operation from either end. The master controller is connected to a train line, so that the entire train can be operated from any one controller.

Junction boxes are used throughout for the purpose of making convenient connections to the train line. The train line terminates in receptacles at the end of the car and is connected between cars by means of jumpers.

TRAIN LINE.

The train line consists of a 12-conductor cable. This line is made continuous throughout the train by junction boxes, train-line receptacles and train-line jumpers. All of the magnets in the train are connected to the train line, and hence may be operated by means of the master controller. By means of the junction boxes it is possible to connect the wires of the train-line cable to those of the master controller switch-group, line switch, line relay, reverser and other pieces of auxiliary apparatus. The wires of the train line terminate in the train line receptacle. Each wire is connected to a separate pin, and each pin is insulated from the other.

TRAIN LINE JUMPER.

The train line jumper consists of two jumper heads connected together by a piece of 12-conductor cable. This jumper forms the battery control circuit between the cars of the train. There are four receptacles per car, but only one jumper is used to connect two train line receptacles. The jumper head and train line receptacle are so constructed that it is impossible to insert the train line jumper in any but the correct position. It is held in place by the spring-actuated cover of the train line receptacle, but will pull out readily in case of accident to the cars.

LIMIT SWITCHES.

Interlocks are placed on the various switches of the switch group and reversers so that the switches can be closed only in a predetermined order. The acceleration of the car is controlled by means of two "limit switches," a motor limit and a trolley limit. During series operation there is a heavy starting current, and when the motors are thrown in multiple the current naturally increases. Thus it is evident that in ordinary series-multiple operation heavy intermediate peaks are thrown on the line. In the equipment being described the motors are always operated in multiple, and in order to reduce the peaks on the line the use of "Motor and Trolley Limits" is resorted to. The combined effect of the "Motor and Trolley Limit" is to smooth out the wave of current.

The motor limit is a coil of high inductance in series with the motor circuit, is operated by low-potential current taken by all of the motors, and is so designed as to allow a certain predetermined maximum current to flow through the motor. The maximum starting current in this installation is 460 amp per motor, or about 1800 amp per car. Thus at no time with the motor limit in the circuit is it possible for the current to reach such a dangerous value as to burn out the motors. Moreover, the total input to the cars is also limited, and the peaks of the line are kept down as much as possible. This is the prime function of the trolley limit (operated by current taken through the trolley). The trolley limit is a coil of high inductance, so designed as to limit the maximum current drawn from the trolley by the car. (See Fig. 2 in article on "Low-Potential Circuit.) The acceleration of the car is still further affected by the "line relay" and by "induction coils" shunted across the field circuits of the motors.

LINE RELAY.

This is a magnet switch opened by gravity and closed by current passing through the coil. This relay is of the low voltage type, so that if for any reason sufficient current is not passing through the coil the armature will drop making contact, thus causing the trolley magnet valve to be energized. Air will then flow into the main cylinder, pull the trolley down, and make the car perfectly safe.

CHOKE COILS.

The purpose of the induction coils is to make the performance curve of the motors more like the direct current motor curve. The theory of the operation of these coils is that the motor is designed with a stronger field than would otherwise be used, and thus gives it a low speed at light loads. When the field circuit is shunted with the coils little effect is had at light loads, but the coils considerably weaken the field at heavy loads and thus make the speed higher than would otherwise be the case.

AIR BRAKE EQUIPMENT.

The controller is provided with a direct connection to the brake pipe by means of the pilot valve and emergency brake valve. The brake valve is controlled by the brake relay valve magnet. When this magnet is energized the valve is opened to the atmosphere and all source of power is cut off from the motors. A cam bears against the stem of the pilot valve and allows air to escape from the upper part of the emergency valve. The brake pipe pressure forces up the piston in the emergency valve and allows air in the train line to escape to the atmosphere, thus applying the brakes immediately.

The air compressor, which is driven by a 700-volt motor, is placed under the car and suspended in a cradle provided with rubber cushions to prevent the vibrations from being transmitted to the car and to deaden the noise.

The compressor is automatically started and stopped by the pump governor. The governor is so adjusted that when the maximum pressure is reached the switch opens the circuit and stops the motor. When the pressure reaches the minimum the switch is again closed and the motor started. Thus the circuit

is made and broken when predetermined maximum and minimum pressures occur in the main reservoir.

OPERATION.

In order to have a clear conception of the operation of single-phase multiple-unit trains, it is necessary to understand the inter-relations between the various circuits described above.

The current passes from the 11,000 volt trolley down the side of the car (through a lorricated conduit) and onto the line switch. From the line switch the current passes through the high-tension winding of the auto-transformer, thus making the low-tension winding alive. The flow of current is then controlled by the various unit switches of the switch group. From the switch group the current passes through the preventive coils, trolley limit, unit switches 9, 10, 11, 12, and on to the motors. From the diagram showing the sequence of switches it will be seen that the unit switches 9, 10, 11, 12 are always in the circuit, and in order to obtain the first point on the auto-transformer (1, 2, 3, 4), it is necessary to move the master controller through four points. To obtain the next higher speed, the auto coil 1, 2 is cut out of the circuit and 4, 5 introduced; thus the second position on the auto-transformer (2, 3, 4, 5) is obtained by advancing the controller handle to point 5, and so on for the other positions. The various currents, as referred to above, can readily be traced from the main wiring diagram shown in Fig. 2.

CENTRAL STATION

MANAGEMENT, POLICIES AND COMMERCIAL METHODS

New-Business Work of Toronto Electric Light Company.

The sales department of the Toronto Electric Light Company has been reorganized, Mr. Martin retaining his position of sales manager and Mr. Eugene Creed, late power chief, becoming assistant sales and advertising manager. The new business secured during the past year has been extremely satisfactory to the company, and the outlook for 1910 is very bright. Two power and four lighting specialists have been added to the department. The sales agents have been very successful in closing sign prospects, so that Yonge Street is now a blaze of light from the Traders' Bank Building to Bloor Street. Many novel signs are in course of erection. The number of heating appliances sold during the holiday season ran up into the hundreds. The demonstrator in charge was kept busy from morning until night, while the delivery service was taxed to the limit.

Notes from Dayton, Ohio.

The City Council of Dayton, Ohio, has authorized the Board of Public Service in that city to take bids upon 300 ornamental lamp-posts, which will be a sufficient number to light the entire business district of Dayton with the special boulevard system of lighting. A sample block of ornamental posts has already been installed by the Dayton Lighting Company and has been in use some time. The plan is to place these posts 90 ft. apart opposite each other. This will give about six pairs of posts per block. A 100-watt lamp is placed on the top globe and four 60-watt lamps on the arms. The 60-watt lamps burn only until midnight.

Tuesdays, Thursdays and Saturdays are market days at Dayton. On these days large numbers of housewives do their buying from market wagons backed up along the curb on certain market streets. The Dayton Lighting Company hires a boy to quietly drop circulars advertising household electric service in the baskets of these women while they are purchasing. Thus the distribution is easy and the circular is likely to receive more attention than if mailed or left at the house.

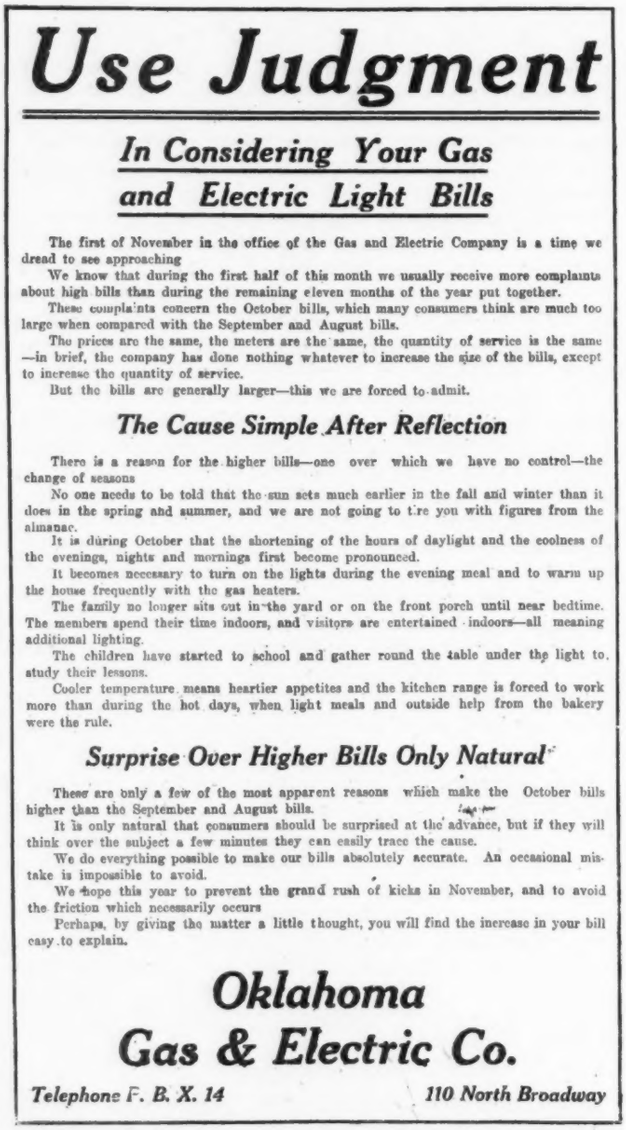
Oklahoma City Publicity.

By Glenn Marston.

Almost a year ago the Oklahoma Gas & Electric Company took up a campaign of publicity which has not only redounded to the credit of the company, but which has brought the community favorably before the country in a number of ways.

Beginning with a series of advertisements setting forth the history of the company, which were prepared by a publicity firm in Chicago, the series developed into a confidential strain setting forth the relations of the company and the consumer, with suggestions as to how the two could co-operate to the best advantage.

After firmly establishing itself in the good-will of the people the company's advertising went into detailed representation of the benefits of electricity. Photographs were taken of the most prominent installations, windows, signs, power, etc. These



Use Judgment

In Considering Your Gas and Electric Light Bills

The first of November in the office of the Gas and Electric Company is a time we dread to see approaching

We know that during the first half of this month we usually receive more complaints about high bills than during the remaining eleven months of the year put together.

These complaints concern the October bills, which many consumers think are much too large when compared with the September and August bills.

The prices are the same, the meters are the same, the quantity of service is the same—in brief, the company has done nothing whatever to increase the size of the bills, except to increase the quantity of service.

But the bills are generally larger—this we are forced to admit.

The Cause Simple After Reflection

There is a reason for the higher bills—one over which we have no control—the change of seasons

No one needs to be told that the sun sets much earlier in the fall and winter than it does in the spring and summer, and we are not going to tire you with figures from the almanac.

It is during October that the shortening of the hours of daylight and the coolness of the evenings, nights and mornings first become pronounced.

It becomes necessary to turn on the lights during the evening meal and to warm up the house frequently with the gas heaters.

The family no longer sits out in the yard or on the front porch until near bedtime. The members spend their time indoors, and visitors are entertained indoors—all meaning additional lighting.

The children have started to school and gather round the table under the light to study their lessons.

Cooler temperature means heartier appetites and the kitchen range is forced to work more than during the hot days, when light meals and outside help from the bakery were the rule.

Surprise Over Higher Bills Only Natural

These are only a few of the most apparent reasons which make the October bills higher than the September and August bills.

It is only natural that consumers should be surprised at the advance, but if they will think over the subject a few minutes they can easily trace the cause.

We do everything possible to make our bills absolutely accurate. An occasional mistake is impossible to avoid.

We hope this year to prevent the grand rush of kicks in November, and to avoid the friction which necessarily occurs

Perhaps, by giving the matter a little thought, you will find the increase in your bill easy to explain.

Oklahoma Gas & Electric Co.

Telephone F. B. X. 14 *110 North Broadway*

AN OKLAHOMA CENTRAL-STATION NEWSPAPER ADVERTISEMENT.

photographs were published in the company's advertising space, with a short summary of the results accomplished by the installation of electricity. Although these advertisements were the company's products, they had a most wholesome effect in

impressing the public with the value of electricity. The merchants and business men thus advertised appreciated the compliment implied by special attention on the part of the company, while the public realized that such testimonials must be authentic and sincere, since the company would not, of course, dare to publish them otherwise.

Meanwhile articles were prepared by the company's publicity department, which have been published in leading magazines and newspapers, indicating the activity of the company in promoting civic improvement.

One of the most recent products of this company is the advertisement shown on page 1572, which is a frank and concise statement of the causes which increase bills during the winter. A unique idea is that of publishing, once a month, the number of complaints received the month before, classifying them as to cause, explaining the steps taken to prevent their recurrence, and asking for more complaints, the company's constant request being to "bring your complaints to the manager, not to your neighbor."

Wilmington (Ohio) Central-Station Notes.

The Wilmington Water & Light Company, of Wilmington, Ohio, operates in a town of about 5000 population, and is under the management of Mr. J. C. Martin, a prominent attorney and capitalist of Wilmington. The company has about 700 electric consumers and 400 water consumers. The relatively small number of water consumers is due to the fact that water service has been given for only about two years.

The company purchased the electric lighting plant from the city in 1902, at which time the plant was in a very decrepit condition. The present substantial electric light and water plant was erected in 1903-4, and service was started on Oct. 1, 1904, from the new plant with 150 consumers. The increase to 700 consumers in five years, therefore, has been rapid.

DAY SERVICE.

Day service was begun three years ago. At that time, in order to get the business, a flat rate of $1.50 a month per horsepower was made. This low rate was made because the company had to maintain a crew to operate its water-works plant during the day in any event, and it was considered that the additional cost of giving day electric service was small. At this rate there were secured several factories and other small users that yielded a revenue of about 4 cents per kw-hour, which was considered satisfactory. However, since taking on more motor load the flat rate does not net so much per kw-hour, and additional business is taken only on a meter basis at a 4-cent rate.

Those contemplating starting day service in a small town and figuring on possible sources of income will be interested to know that as a result of starting day service in Wilmington there was an increase of $250 per month in revenue from commercial lighting caused by the use of light in stores and basements during the day time. The starting of the day service was also useful in meeting a very active gas competition.

The company operates 143 alternating-current, 6.6-amp, inclosed street lighting arcs, which indicates that the town is unusually well lighted for one of its size.

EFFECT OF INSTALLING METERS.

With 150 customers at the start, the apparatus then in use was fully loaded. These customers were all on a flat rate. The company put on 100 meters and began to give all-night service, while previously service had been given only until 11:30 p. m. The result of the installation of meters was to reduce the coal bill by two-thirds, in spite of the additional hours of operation. The company also added 75 more consumers without increasing the station equipment.

EMPLOYEES.

The company employs, in addition to the manager, who gives only a part of his time, 11 men for the maintenance and operation of the water and lighting plants and the carrying on of a contracting and supply business. These men are as follows:

One lineman, one assistant lineman, two interior wiremen on contracting and consumers' repairs, one man to make water connections, one collector, one bookkeeper and stenographer, four power-station men. The power station is operated with two men on a shift.

POWER PLANT.

The power plant is a substantial brick building containing steam water-works pumping apparatus in addition to the electric generating plant. There are two 250-hp Erie water-tube boilers, both of which are kept in operation continuously. The generating equipment consists of one 225-kw, two-phase, 60-cycle Bullock alternator belted to an I. & E. Greenwood Corliss engine and a 115-kw alternator belted to a Lane & Bodley Corliss engine. The average indicated horse-power on the plant for a typical day in June, 1909, was measured as 226 for a 24-hour run. Similar measurements for a day in March, 1909, indicated 256 hp. The high average load is caused by the steady demand of factories using electric motors.

A very simple method of weighing coal is employed. Coal is taken from the coal storage to the boiler room on a four-wheeled truck of the usual type for such purposes. It has been found that the amount of coal per truck averages 1000 lb. The door between the boiler room and coal storage is just about wide enough to allow the truck to pass, and an iron frog is placed on the floor near the coal-room door, so that whenever the truck goes through it must operate a projecting lever arm. This lever arm, whenever pushed in a direction away from the coal room, makes an electrical contact, closing a circuit, which causes current to flow through the coils of an electro-magnet which operates a cyclometer counter in the engine room. Every time a truck load of coal passes the lever, therefore, it moves the cyclometer counter along one notch and records 1000 lb. of coal. The cyclometer therefore reads directly in 1000 lb. of coal, and the chief engineer does not have to rely on the firemen's record for the number of truck loads.

Formerly much trouble was experienced with scale in the boilers. The company had a 14,000-gal. cypress tank on hand, and from this Mr. W. E. Turner, chief engineer, built a water-softening plant that cost about $350, exclusive of the tank. The water is treated according to the usual lime and soda-ash process. Saturated solutions of lime and soda ash are fed into the tank by means of a certain proportion of the feed water which is by-passed through the solution tank. The feed water entering the tank falls over an overshot water wheel for stirring the solutions. Trouble from scale has been practically eliminated by the softening of the feed water in this way.

Central-Station Improvement Costs at Athol and Orange, Mass.

In connection with a petition recently submitted to the Massachusetts Gas and Electric Light Commission for authority to issue new capital stock, the Athol Gas & Electric Company filed several detailed estimates of the cost of improvements in its territory which are of general interest. These related in general to a 400-kw enlargement of the Wendell power station, to the addition of a 650-kw reserve steam plant at the same point, the construction of new motor service and street-lighting circuits, and to certain transformer changes. The more important electrical estimates are given below on account of their value as specific analyses of improvement cost. The company states that the work has progressed so far that the accuracy of the estimates is thoroughly well established.

ESTIMATE OF ADDITIONAL 400-KW WATER-POWER UNIT.

Two pairs 33-in. horizontal wheels (f. o. b. Wendell)	$4,500.00
Lining and grouting same	450.00
One 1½-second Lombard governor	1,250.00
Setting and connecting governor	140.00
400-kw, 60-cycle, three-phase, 2300-volt alternator (f. o. b. Wendell)	6,900.00
20-kw, 125-volt exciter, directly connected to generator	850.00
Foundation and erection of generator	300.00
Electric connections to switchboard, oil switch, ammeter	275.00
Total	$14,665.00

The estimated cost of the addition per kilowatt of generating rating was $36.66.

ESTIMATE OF 650-HP ADDITIONAL STEAM PLANT.

650-hp compound condensing engine (f. o. b. Wendell)	$6,000.00
213-hp Stirling boiler, set complete	3,150.00
One 8x10x8-in. boiler feed pump	225.00
One 10x18x20-in. horizontal jet condenser	850.00
One 10x16x18-in. horizontal jet condenser	500.00
Chimney, 110 ft. high, 40.5 ft. diameter	2,200.00
Steel breeching boilers to chimney	450.00
600-hp open heater	950.00
Resetting present engine in new position	350.00
Steam piping complete, with fittings	2,350.00
Foundation and erection of engine	425.00
Alterations in boiler house, including roof	1,200.00
Excavation and concrete walls for coal bunker	750.00
Hand-operated traveling crane, 7 tons, 40-ft. span	1,000.00
Total	$20,400.00

The engine is of a type specially designed to run at the generator speed, 200 r.p.m. It is planned to run the engine and water-wheels together when necessary by throwing out the water-wheel governor and setting the wheels at one-half or one-third gear, according to the flowage in the stream, and letting the engine take care of the fluctuations in load. The feed pump is of a rating sufficient to handle the full boiler equipment. The smaller condenser is to be attached to the present engine, which is a non-condensing outfit. The chimney estimate consists of $1,800 for a Custodis section 100 ft. high, with $400 for the concrete base, including foundations and building up to 20 ft. above grade. The high-pressure pipe covering is to have 85 per cent magnesia and the low-pressure 50 per cent. The width of the boiler house is to be practically doubled, and a concrete roof installed. The plant is located beside the Boston & Maine Railroad, and aside from the chance of fire, it was deemed wise to put a concrete slab over the boiler house in place of the present wooden roof. The estimated cost includes moving out the present boiler house far enough to erect a fire wall, cutting off part of the present power house. Part of the old plant will be dismantled and a fire wall built. Between the boiler house and the railroad track is a convenient coal storage space, which can be utilized at small cost on account of a difference of 12 ft. in the elevation of the tracks and the boiler-room floor. A concrete wall is to be built directly under the track with facilities for unloading by gravity into the coal pocket. The crane estimate consists of $400 for trackway and supports and $600 for the crane proper.

ESTIMATED COST OF NEW MOTOR-SERVICE LINES TO ORANGE.

9000 lb. wire at 17 cts	$1,530.00
150 4-pin cross-arms with pins, insulators, bolts, braces	210.00
Erecting the above wire	200.00
Meters	600.00
Transformers	2,800.00
Transformer stands and erecting	300.00
Service connections, including setting meters	250.00
Incidentals	300.00
Total	$6,190.00

ESTIMATED COST OF NEW MOTOR-SERVICE LINES TO ATHOL.

18,000 lb. wire at 17 cts	$3,060.00
374 4-pin cross-arms, with pins, insulators, bolts, braces	525.00
Erecting the above wire	400.00
155 chestnut poles set	1,123.75
Meters	1,200.00
Transformers	5,600.00
Transformer stands and erecting	600.00
Service connections and setting meters	400.00
Incidentals	500.00
Total	$13,408.75

DISTRIBUTION LINES AND ARC-LAMP INSTALLATION AT ORANGE.

3 miles No. 1 copper wire... / 21.2 miles No. 6 copper wire. / 16840 lb. at 17 cts	$2,977.04
475 chestnut poles	2,137.50
Setting and guying poles, including tree trimming	1,575.00
566 cross-arms with pins, insulators, etc	718.00
96 transformer stands, installed	1,282.00
Erecting 24.2 miles of wire	1,800.00
354 service connections to customers, including setting meters	4,740.00
Incidentals	650.00
Total	$15,879.54

About three miles of streets are to be covered by the Athol lines, there being about 2600 ft. of No. 0, 20,000 ft. of No. 2, and 17,500 ft. of No. 4 weather-proof wire. The extension of street-lighting circuits will require 115 new poles, with 40 new poles for purely motor-service lines. In the case of these poles an allowance of from $2 to $2.50 was made for setting. The first cost per pole varied from $2.75 in the case of small poles at the ends of streets where no possibility of motor business exists to $8 or $9 in the case of the heavier poles with concrete foundations and carrying transformers.

ARC LAMPS.

6 commercial enclosed arc lamps, installed, at $35	$210.00
46 public street arc lamps, at $50	2,300.00
70 series street lamps, 32 cp	87.50
70 goose-necks and fixtures	420.00
37 Nernst lamps	332.20
Total	$3,349.70

INTERIOR WIRING AND ILLUMINATION

Holiday Lighting in Pennsylvania.

For the past year or two business men in various parts of Pennsylvania have utilized electricity to hold the local market and to increase sales in the Christmas and New Year shopping period. The details of the plans vary with the different cities; but the general scheme is to arouse the Christmas spirit, to make the city and the stores assume an air of the chief festal occasion of the year, to induce people to come into town to see the decorations and to participate in the general jollity and good feeling of that time of the year. In this manner people are brought to the city from points within convenient reach and the attractive displays in the stores induce increased shopping.

At Wilkes-Barre, Pittston, Sayre and Waverly the streets are at present illuminated by means of incandescent lamps festooned across the roadway in many cases, but chiefly along both sides of the street on the outer edge of the sidewalks. The lighting is supplemented by other attractions, such as parades, flag raisings, speechmaking, etc. As indicative of the class of attraction often given, the three weeks' festival at Elmira, N. Y., last year is typical. The carnival, which ended on New Year's day, had as its opening feature a street car pulled over the main street by three elephants, on one of which Santa Claus was seated. This novel, though by no means elaborate, parade was viewed by some 30,000 people, most of whom remained in the business section for many hours, with the result that the holiday sales were greater than ever. At Waverly there was a night parade on Dec. 16, in addition to extra carnival lighting paid for by the merchants. This parade drew people from Sayre, Athens and Elmira, taxing not only the streets in Waverly, but the transportation facilities as well.

Show-Room Windows at Dayton, Ohio.

The Dayton Lighting Company has an excellent show room on a prominent downtown corner. In this show room there is a large amount of window space by virtue of its being on the corner, with show windows on each street. These windows are arranged according to high-class ideas of show-window displays, with but a few appliances in each window, so that attention is not distracted by the multiplicity of things to be seen. The displays in these windows are changed every Friday. Even the lettering is changed. Temporary letters which make an excellent appearance for a week are cut from plain white paper and pasted on the windows. These letters have the general appearance of high-priced porcelain letters. Before Christmas for one week considerable prominence was given to the new Federal shaving mirror, which is provided with a tubular lamp and reflector below the mirror, and forms a complete lamp and mirror unit, which can be set on a chiffonier top or any other convenient place.

In the basement the company maintains a sample show window to illustrate the effect of different methods of lighting a given window. This window is fitted up with dry goods. One plan of lighting is by the old method of placing a border of 16-cp lamps at the top, bottom and sides of the window. Another method is by tungsten lamps with prismatic reflectors hung from short fixtures in the center of the window ceiling. The third and most approved method is by means of a row of tungsten lamps in concentrating prismatic reflectors placed at a slight angle, pointed inward, next to the window pane. Just in

front of the row of lamps on the window pane is a sign with a black-paint background and translucent letters which the lamps serve to illuminate. Merchants are taken to the basement to see this practical demonstration of the striking effects of the various methods of lighting.

A Semi-Concealed Church Lighting Installation.

An unusual lighting installation of considerable interest has been made in a building in Chicago erected for a church and now occupied by the Jewish Institute. The interior of this audience room, which is of the Gothic style of architecture, is shown in the accompanying engraving. The electrical installation and lighting were planned by Mr. J. N. Pierce, president of the Pierce Electric Company, which had the contract for the wiring. The architect did not wish to intrude any fixtures below the arches, and the contractor fully appreciated the desirability of keeping lamps out of the range of vision. He consequently arranged a scheme of lighting whereby no lamps are directly visible to a person seated in the audience. The lamps are so arranged that the eyebrows, ordinarily, completely shade the eyes.

Lighting is accomplished by placing tungsten lamps in opaque silvered, mirrored, concentrating reflectors at the apex of the cross arches. The effect is rather better than is shown by the photograph, as the photograph brings out contrasts more strongly than they are apparent to the eye. On each side of the central arch are mirrored-surface helmet reflectors, which were designed primarily for high show-window lighting and are very concentrating. These reflectors are placed flush with the arched ceiling. On each side of the central arch at the apex is a 60-watt tungsten lamp in a conical reflector of the mirrored-surface type. There are two 100-watt lamps concealed in niches on each side of the platform, and also two 100-watt lamps concealed behind the arches over the platform. The main audience room, exclusive of the platform, is 78 ft. 5 in. x 51 ft. 3 in., making an area of approximately 4000 sq. ft. For lighting this area 1800 watts in tungsten lamps are required, or a little less than 0.5 watt per square foot. The height to the center arch is 35 ft. The height of the arches on either side is 29 ft. The effect is rather unusual. One of the objects of this design—

SEMI-CONCEALED CHURCH LIGHTING.

namely, that of keeping direct light out of the eyes of the audience—is well accomplished. The architect is also well pleased on account of the general effect and the absence of obtrusive fixtures. Reflectors which distribute light efficiently over a little wider angle than the helmets used in this case were not known to be available at the time this installation was made, but would have been desirable. The illumination on the seats is more than ample as regards reading purposes. The direction of most of the light rays is so nearly perpendicular, however, that the faces of persons a little distance away appear to be insufficiently lighted. Thus the illumination is rather deceptive. This drawback could be partially overcome by using reflectors of later design, giving a somewhat wider light distribution. These reflectors would show less light on the horizontal reading plane, but would eliminate some of the shadows caused by the perpendicular rays on the faces of persons in the audience. For audience-room purposes, however, the present arrangement is very comfortable and efficient. The extra lighting of the stage gives ample illumination on the faces of speakers. Illumination on the faces of the audience is of secondary importance. Comfort of the eyes is first to be considered, and, second, ability to read easily, both of which are accomplished by the plan used. Architecturally the effect is excellent, and, as said before, much better than appears from the photograph.

Street Arches at Wilkes-Barre, Pa.

The public square at Wilkes-Barre, Pa., instead of being lighted as heretofore by means of arc lamps located at street intersections, is now lighted by arches of tungsten lamps strung at intervals from curb to curb. In all there are 240 60-watt, frosted-tip, tungsten lamps employed, arranged in 24 arches each of which contains 10 lamps. To make the arches alike, a span wire is stretched across the roadway from pole to pole

FIG. 1.—EAST SIDE OF PUBLIC SQUARE.

and attached to this are 10 triangular-shaped, paraffine-soaked pieces of wood about 4 in. long on a side. A hole is provided in each corner of the wooden triangles, the span wire passing through the upper one, and the two lower holes are used for

FIG. 2.—SOUTH SIDE OF PUBLIC SQUARE.

the electrical conductors. The lamps are fed from the latter as indicated in Fig. 3, one lead being attached in front of and the other in back of the wooden triangle. By this means a very symmetrical set of arches is obtained. The arches are spaced

70 ft. apart and the length of the span is 40 ft. The center lamp is placed about 25 ft. above the roadway and the sweep of the arc is quite regular, as will be observed from the engravings.

A porcelain-enameled shade is fitted to a skirted porcelain socket of the type shown in Fig. 3, the feature of which is that it forms both a drip loop and an extra support for the wires relieving the contacts from tension and giving a drop lamp which hangs plumb. At present 100-volt lamps are employed in the arches, fed from alternating-current mains passing around the square. It is the intention to replace the lamps with 10-volt tungstens arranged 10 to an arch and 10 arches being then connected in series across the present 100-volt circuit. In this

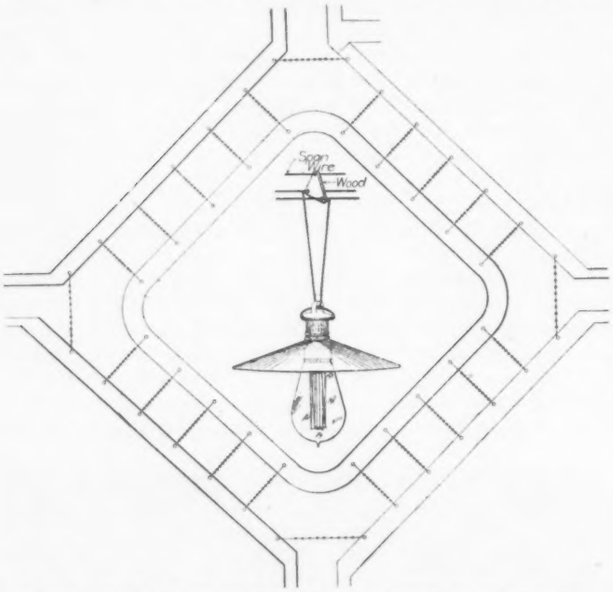


FIG. 3.—DIAGRAM OF ARCHES AND OF METHOD OF SUSPENSION.

way longer life will be obtained and breakage due to wind and storm minimized. The arches are rather inconspicuous during the day and the distribution of light from them at night is quite even and pleasing. The arches form part of the regular city lighting service contracted for by the Wilkes-Barre Gas & Electric Company.

Street and Show-Window Illumination.

It is high time again to call attention to the annoyance, if nothing worse, produced by the prevalent custom of hanging arc lamps provided for the purpose of display too near the sidewalk. With the increasing use of powerful flaming arcs for display purposes, has come a state of things which is needlessly distressing to the man in the street. Used for street lighting, or swung high, such lamps are extremely valuable owing to the flood of light they give, and when they are far removed from the eye the effect of their high intrinsic brilliancy, after all much lower than that of the unshielded arcs they have replaced, is not serious. When, however, they are brought within 10 ft. or 12 ft. of the sidewalk the results are somewhat painful. If there were need of thus placing them in order to obtain the desired illumination, some question might arise as to the propriety of their use; but when, as a matter of fact, a lamp 20 ft. or 25 ft. up gives all the light that can reasonably be desired, there is no proper reason for putting them so low as to annoy the passersby. The practical cause of thus suspending them is, we think, no desire on the part of the users to produce unpleasant results, but merely the fact that one occupying the first floor of a building cannot readily obtain the necessary location for hanging his lamps high. The remedy, however, is simple enough. One can obtain the most brilliant and attractive effects for display purposes by proper screening of the lamps. Proper grouping of smaller sources of light will obtain equally striking results without any greater expense and without causing any glare upon the sidewalk. There is no need of using a 2000-cp or 3000-cp source in a 10-in. or 12-in. globe in order to attract attention. The situation offers a good chance for missionary work on the part of the electric supply companies and those who furnish fixtures for display lighting. One occasionally sees on the streets very rich and beautiful effects of most attractive character produced without resorting to extreme means, and we are inclined to think that these attract more beneficial attention from the public than do the cruder devices.

The subject of artistic electric signs and display is one which is receiving some attention, but considerably less than it deserves. There are excellent examples now in use and there ought to be very many more. It is the unusual and the beautiful in illumination that catches the eye, which after all is the essential point in all advertising. Electric advertising is only in its infancy, as the public is wont to say of many things electrical. The huge plain sign in lines of light is useful in its proper place. Experience has already shown, however, that it can be replaced by something much finer in effect when it comes to signs not intended for visibility at a great distance, but to attract compelling attention. On narrow streets in particular, the need of artistic novelty is strongly felt, and the chance for skilful design in this work is almost unlimited. A little attention to this matter ought to bring good results, both to those who advertise and to those who supply the material. The time has gone by when a huge light thrust out over a doorway is either novel or edifying. This sort of garish display is most unpleasant so far as the public is concerned, and we do not see why it should not be subject to regulation like other matters pertaining to signs. Occasionally one sees some flagrant offender in the matter of window lighting, such as glaring lamps thrust forward in the eyes of the passersby. This is almost as offensive as the obtrusive arc, and cases have arisen where the effect of such lighting has been to injure neighbors across the street. A plate-glass window is a very good mirror, and when it reflects with offensive brilliancy the lights without, the effect of lighting within is in a great measure lost, with a result distinctly annoying to the passersby. This particular matter cannot be easily remedied except by an appeal to the courtesy of the advertising public, but it is a matter which should be borne in mind. The glaring arc, however, can be and ought to be abolished; regulations governing its use would be welcomed by the public at large and would not, in view of the many resources of electric advertising, bear heavily upon the present, often unwitting, offenders.

New Telephone Patents.

"BALLAST" SWITCHBOARD SYSTEM.

In the so-called "ballast"-type, common-battery switchboard system, the signal lamps operate in series with the subscriber's line, and thus with a common and uniform source of potential the current in the lamps varies with each length of line. Ordinarily, this is overcome by including the lamp in an exclusively local circuit, controlled by a relay. This latter is in turn included in the subscriber's line circuit and being capable of satisfactory operation over great ranges of current strength, the varying line resistance is of no effect. On the other hand, the allowable range of a lamp is small and to reduce the effect of the subscriber's line resistance, a ballast resistance is inserted which will make the net changes at the lamp terminal small. It will be evident that the ballast may be of so high resistance that the difference between the resistance of the shortest and longest subscriber line produces an unimportant effect at the lamp terminals. Again, the ballast may have a counteracting temperature coefficient, its resistance mounting rapidly as the current flow exceeds the normal flow.

Such a ballast may be made one with the signal lamp, in which case a tungsten or tantalum lamp may be used. This will give a double ballasting effect: the one due to the high

internal resistance of the lamp and the other the effect of coefficient. Mr. J. N. Wallace, of La Crosse, Wis., has patented such an arrangement of combined lamp and ballast, having assigned his patent to the Vote-Berger Company.

IMPROVEMENTS IN SEMI-AUTOMATIC SYSTEMS.

In the semi-automatic system a central-office operator is usually required to carry out a part of the switching, this part varying with different systems. In the present case, on plugging in and receiving a number, she selects through automatic means the desired number and then disconnects herself. It is this latter step with which we are concerned, Mr. William Christensen, of Belmont, Mass., having found that unnecessary time was consumed in directing the attention and moving the hand to the particular listening key through which the connection was maintained. He therefore mounts a trip bar along the keyboard, a single depression of which will release any of the listening keys which may chance to be set. It will thus be seen that the trip of the listening keys becomes mechanical, requiring no attention whatever and being accomplished alike for any or all keys. The patent for this arrangement is assigned to the American Telephone & Telegraph Company.

The patent granted to Mr. D. S. Hulfish, of Chicago, Ill., and assigned to McMeen & Miller, relates to a very different method of operation. In his system, a team of operators is assigned to a group of lines, the answering terminals and line signals of which are multipled to appear before each. Each operator has a rotating arm serving as a call-finder. This arm trails continually over a row of contacts to which the various lines are connected in proper series. As soon as a calling line, unanswered, is reached, the arm stops, displays a signal to the corresponding operator and then on being released proceeds upon its way. Thus it will be understood that each call is automatically distributed to that operator best able to handle it. Further, the number of positions in any team may be reduced at any time by merely stopping the corresponding machine upon a neutral contact.

ANTI-SIDE TONE OR REPEATING CIRCUIT.

The anti-side tone and the repeater circuit problem are the same for at least one feature, viz.: the transmitting element must not have any effect upon the receiving element. The scheme contemplates the use of a coil with an adjustable core and with two windings. These latter are so arranged that one is in the circuit of the receiving element and the other in that

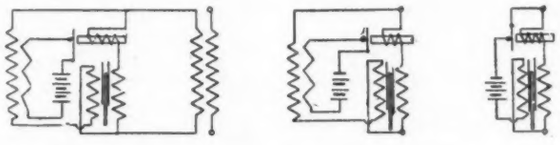


FIG. 1.—ANTI-SIDE TONE OR REPEATING CIRCUIT.

of the transmitting element. The coils are so connected that the induced current in the receiving circuit opposes the current which would flow because of the conductive relation. The inductive effect is adjusted by means of the core until a balance is effected. The illustration shows rudimentary circuits which may assist in understanding the arrangement.

SUBSCRIBER'S STATION APPARATUS.

When one is working in the ordinary type of bell box, the sides of the box, in close proximity to the apparatus, are sometimes an interference, especially if the adjustment to be made is deep in the box. To obviate this, to some extent at least, Mr. C. E. Oxford, of Fayetteville, Ark., has not only provided his bell box with a door, but he has arranged it so that the whole thing may be lifted off the base to gain access from the rear. The electrical circuits must, of course, be provided for by means of registering clips which readily separate and recontact.

An antiseptic device forms the subject of a patent granted to Mr. Geo. Rowlands, of Schenectady, N. Y. The invention has an antiseptic surface which is hygroscopic, and therefore remains moist, so that germ-laden material will stick to it.

A switching attachment for party lines has been invented by Mr. C. B. Mitchell, of Franklin, Tex. The line is cut through the switch so that when the telephone is being used in one direction, the leg of the line going the other way is cut off the talking circuit and is connected to the bell. The return of the receiver to the hook serves to trip off the switch after use so that it will assume its normal position.

SWITCHBOARD SYSTEMS.

In the divided multiple, multi-signal system it becomes necessary to give the subscriber means to select that one of his line signals located upon the division of the switchboard carrying the multiple of the desired number. The selection may be effected by varying the flow of current so as to cause relays to fail under one current and operate under a greater one. This current flow is, of course, controlled by cutting in different resistances at the subscriber station. For example, in Fig. 1 the

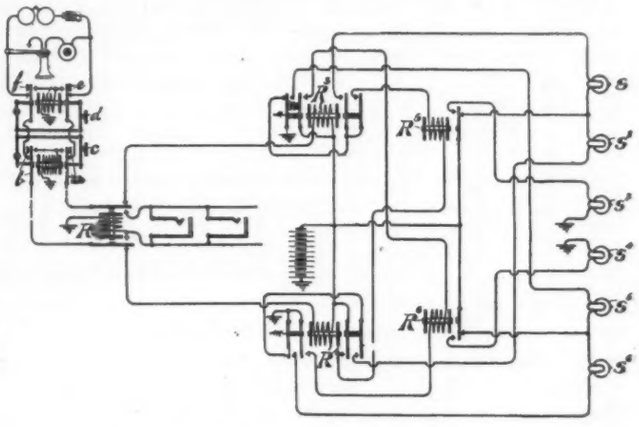


FIG. 2.—WEBSTER SWITCHBOARD.

relays R^3 and R^4 are two-stage, shifting their right-hand contacts on low currents and all contacts on high currents. The keys at the subscriber station are magnetically locked. Key *a*, high-resistance, operators lamp *S*, through partial operation of relay R^3. Key *b* through R^4 lights S^2. Lamp S^5 requires full operation of R^3 and S^6 of relay R^4. Relay R^5 responds to partial operation simultaneously of R^3 and R^4 and relay R^6 of full simultaneous operation. There are other combinations which might be arranged, but the above is typical.

Mr. H. G. Webster, Chicago, Ill., has been granted a patent for this change of resistance method of control, having assigned his patent to the Kellogg Switchboard & Supply Company.

The patent granted to Mr. C. L. Zahm, of Los Angeles, Cal., deals with an improvement in automatic systems, which lies in the substitution of a bridged battery for talking purposes at or near the completion of the operation of the connector. This bridged battery is cut in through the two windings of a release relay which, being upon opposite ends of the core, act as impedances for talking currents and differentially for steady currents.

OUTLYING SELECTIVE SWITCH.

At times it is desired to control over a main line a distant or outlying switch, to connect a branch line to the main line. Mr. John H. Swanson, of Baldwin, Wis., has invented such a switch, which is of rather simple construction. A polarized magnet is provided with two armatures. One is a tilting armature such as is used on a ringer. The other is a contact armature. This latter will not respond to an energization of the magnets by the weak main line current, but it will respond to a local winding. When a main-line current of proper polarity arrives, the tilt armature responds, closing the local circuit. The contact armature now responds, connecting in the branch line. The contact armature shunts the magnetic field and permits the tilt armature to restore, but the contact armature is held by the polarizing magnet. An alternating current serves to dislodge this armature when disconnection is desired.

Letter to the Editor.

Polyphase Magnetomotive Forces.

To the Editor of Electrical World.

Sir:—The writer wishes to thank Mr. John D. Nies for his letter in your issue of Nov. 11 criticising a letter in your issue of Oct. 14 relating to polyphase magnetomotive forces. On account of an erroneous assumption that the torque due to the fictitious motor III increases from standstill instead of decreasing, the maximum value of the negative torque was shown in the diagram at a slip of + 166 per cent in the case of backward running instead of at + 133 per cent, as properly stated by Mr. Nies in an article in your issue for Aug. 26.

It seems well to call attention to the fact that in my letter no attempt was made to expound any new method for calculating flux and induced e.m.f. in an induction motor, but merely to point out that the effective e.m.f. induced by a distorted flux wave cannot be determined by calculating the values of the individual fictitious components and adding them algebraically, as one is apt to infer from the statements in Mr. Nies' article. That is to say, the method given by Mr. Nies is likely to be confusing and misleading. It should be remembered that the field at any point of a magnetic circuit is defined by its strength and its direction—not directions—that is, it is a vector quantity. Hence there is no such thing as one flux moving at a certain speed in one direction and another flux moving at a different speed in the opposite direction. In a distorted flux wave it is customary to consider the harmonics individually in some cases, in order to express mathematically the effects produced by the deviation from the true sine shape, but the method used by Mr. Nies is not permissible.

During the past 10 years the effect of the distortion of the field flux upon the performance of induction motors has been investigated by many engineers. Their investigations have shown that when a motor does not accelerate to synchronism but runs at some definite speed which is a fraction of the synchronous speed, the trouble can be overcome without recourse to a fractional-pitch winding. In the case of a motor with a squirrel-cage rotor, the selection of the proper number of bars per pole per phase will insure a good performance, while when the rotor is of the coil-wound type the starting resistance may easily be so selected that the irregularities in the speed-torque curve are smoothed out during acceleration.

Chicago, Ill. Henry Hermann.

DIGEST OF CURRENT ELECTRICAL LITERATURE

Abstracts of the important articles appearing in the electrical periodical press of the world

Generators, Motors and Transformers.

Automatic Voltage Regulation of Alternators.—M. Seidner.—A continuation of his extensive article giving brief descriptions of and critical remarks on various methods of voltage regulation of alternators. In the present instalment he deals with the methods of Corsepius, General Electric Company, Alexanderson, Hutin, Boucherot, Rice, Danielson, Union Elek. Ges., Steinmetz, Le Blanc, Walker and Heyland. The article is to be concluded.—*Elek. Zeit.*, Dec. 9.

Ratio of Transformation of Transformers.—E. B. Rosa and M. G. Lloyd.—A theoretical article on the determination of the ratio of transformation and of the phase relation in transformers, with application to potential and current transformers. The results of tests are given in tables and diagrams.—*Bull. Bureau of Standards*, Vol. 6, No. 1 (October).

Mercury-Vapor Rectifier.—F. von Keller.—An illustrated lecture before the Berlin Electrical Society on the Cooper Hewitt mercury-vapor rectifier and its application in practice.—*Elek. Zeit.*, Dec. 9.

Lamps and Lighting.

Train-Lighting System.—In a single-battery train-lighting system developed by the Tudor Accumulator Company the generator is spring-suspended and belt-driven from a coach axle. The machine is placed in circuit at 300 r.p.m. and the voltage is kept down with rising speed by an opposing series field. An automatic switch reduces the shunt excitation when the battery is fully charged, and the lamp pressure is kept constant within 4 per cent by means of iron-wire series resistors. Fifteen cells are required, the lamp pressure being 24 volts. The connections are illustrated in Fig. 1. With the coach at rest the lamps are supplied with energy from the battery, and as there is no voltage across the generator brushes, the switches *A* and *B* will be in the open and closed positions, respectively. As the coach starts the brush rocker will move into the proper position to excite the machine, and the field current will pass from the brush through the shunt field winding to the two groups of iron-wire resistors *RP* (which allow a definite current to pass, independent of a large voltage fluctuation); here it splits up and a definite portion passes to the terminals 1 and 2 of the switch *B*, and thence to terminal 3 and through the resistor *K* to the positive brush. As soon as the machine attains a speed of 300 r.p.m. it generates the necessary voltage and the main switch *A* closes; as the speed further increases, the output rises and when the current exceeds the lamp load the excess goes to charge the battery. When the battery voltage attains the full charge value the switch *B* breaks circuit at the terminals 1, 2 and 3, so that the resistors *P* are cut out. This action decreases the field current, and the generator output is reduced to the lamp load, the remaining field current being that flowing through resistors *R* and *M* and switch *S*. If, now, the main lamp switch *S* is opened, the field current is reduced to a very small value, namely, that which passes through the group of resistors *R, M, N* and *K*. This small field current is just sufficient to make the generator give 2 amp or 3 amp at high speeds, and serves to top up the battery and prevent switches *A* and *B* from hunting. As the generator speed decreases the output gradually falls, switch *A* opens, and when it comes nearly to rest, *B* closes. The lamps *L* are permanently connected across the battery and are run in series with iron-wire

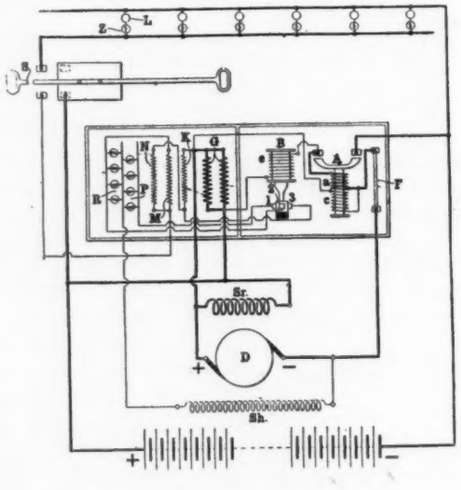


FIG. 1.—DIAGRAM OF CONNECTIONS.

resistors *Z*, which absorb the fluctuations due to the battery either being on charge or discharge.—Lond. *Elec. Eng'ing*, Dec. 9.

Metallic-Filament Lamp.—A note on a recent British patent of the French Welsbach Company (24,212, 1908; Dec. 2, 1909)

for supporting metallic filaments. A central porcelain rod carries a series of nickel-wire supports forming a helix. Fine platinum or platinum-iridium hooks are fused to the ends of the supports. These lessen the cooling of the filament by conduction, and do not melt at the high temperature attained by the filament.—Lond. *Elec. Eng'ing,* Dec. 9.

Two-Hundred Volt Osram Lamp.—A note stating that since the General Electric Company has placed its 32-watt, 200-volt osram lamp on the market, over 500,000 lamps have been sold. The company and its agents have been rather behindhand on deliveries both of this size and other sizes recently.—Lond. *Elec. Eng'ing,* Dec. 9.

Beck Lamp.—A note stating that the German Beck lamp patent which has been revoked is not the fundamental one, but a later one for a particular arrangement in which the negative electrode is supported.—Lond. *Elec. Eng'ing,* Dec. 9.

Arc Lamps.—J. LADOFF.—The first part of a historical review of the use of conductors of the second class (electrolytic conductors) as arc-lamp electrodes.—*La Lumière Elec.,* Dec. 11.

Generation, Transmission and Distribution.

Steam Turbine.—ANDRE.—The conclusion of his article on the Barbezat steam turbine. An actual installation of this turbine is described with a detailed account of the results of tests. —*La Lumière Elec.,* Dec. 4.

Traction.

Abandonment of Electric Operation on the Seebach-Wettingen Road.—For several years the Oerlikon Company has operated the Seebach-Wettingen road electrically and has made extended studies of heavy electric traction on this line. It had been hoped that the Swiss railroad department would buy the electric equipment, but it has not done so, since it was found that, even with the lowest rate at which electrical energy was offered, operation would cost from $14,000 to $17,000 a year more than steam traction. The road in question is not specially suitable for trials with heavy locomotives and high speeds on account of the comparatively weak track construction and its many curves and grades. The railway department asked the Oerlikon Company to continue electric operation and was willing to pay from $2,000 to $4,000 per year to the Oerlikon Company, but the latter decided to abandon electric operation, since the department did not want to buy the equipment outright.—*Elek. Zeit.,* Dec. 9.

Tramway Costs.—The first part of an article on electric tramway costs and statistics. The article is illustrated by numerous forms of records.—Lond. *Elec. Review,* Dec. 10.

Bow Collectors.—A. SCHMIT.—An illustrated comparison of the relative advantages of bow collectors and trolley-wheel collectors, pointing out the advantages of the former.—Lond. *Elec. Eng'ing,* Dec. 9.

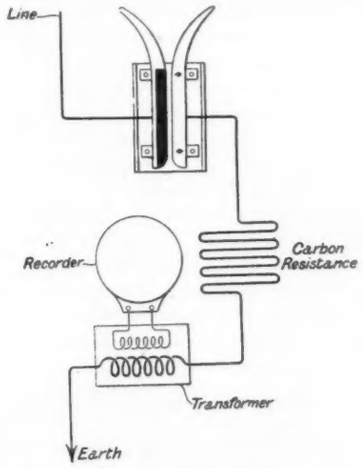


FIG. 2.—DIAGRAM OF CONNECTIONS.

Installations, Systems and Appliances.

Recorder for Lightning Arrester.—An illustrated description of a recording device for showing when lightning arresters and other protective spark-gaps have been in action, which is in use on the Heysham-Morecambe section of the Midland Railway. The arrangement is shown in Fig. 2 in which the spark-gap is of the horn type, with the "line" side of the gap faced with carbon. The other side is connected through a special non-inductive resistor and the primary of a small transformer to earth. The secondary of this transformer actuates a simple form of recorder. This instrument has the movement of the pointer constrained by two steps, so that the passage of a current impulse, due to the spark-gap having been in action, makes a V-shaped notch in the line traced by the pen. The circular disk chart revolves once in 24 hours, and the position of the stop is shifted by hand every day, so that the traces for every day of the week are concentric circles. The carbon resistor consists of a zigzag groove of special shape in a fire-clay block containing a special carbon powder.—Lond. *Elec. Eng'ing,* Dec. 9.

Circuit-Breaker.—An illustrated description of a simple circuit-breaker made by a British company. One coil serves as both overload and blow-out magnet, and carries the whole current. There are no springs and remarkably few working parts. A fuse in the body of the switch is in series with the main contacts.—Lond. *Elec. Eng'ing,* Dec. 9.

Wires, Wiring and Conduits.

Price of Copper.—GLIER.—The first part of a statistical article on the fluctuations of the copper price during the last 40 years. The author begins with statistical data showing that the price of coal, wheat, meat, cotton and metals has gone up during the last 40 years and that it is wrong to make protective tariffs responsible for this general and international rise of prices. With respect to copper, data are given on the prices in Frankfort, Hamburg, England and the United States. There have been large fluctuations of the price of copper, but in general there is a rising tendency. Six times since 1879 the price of copper imported to Hamburg per 220 lb. was below $25 (in 1886, 1887, 1894, 1895, 1896 and 1897), but since that time this has not occurred; even the enormous drop of the price of copper from 1901 and 1902 and that from 1907 and 1908 did not bring the price for 220 lb. again below $25.—*Elek. Zeit.,* Dec. 9.

Definition of Conductors and Cables.—The conclusion of the report of a committee of the Berlin Electrical Society (H. Diesselrost and F. Emde) on the definition of the electric properties of conductors and cables. The present instalment is chiefly of mathematical character.—*Elek. Zeit.,* Dec. 9.

Electrophysics and Magnetism.

Insulation of Induction Coils.—A. CAMPBELL AND J. L. ECKERSLEY.—With high-frequency coils, such as are used in wireless telegraphy and even with telephonic frequencies, the distributed capacity of a highly inductive coil (say 1 henry) will show itself by altering the effective resistance and inductance. But there are in addition the effects of low insulation in such cases. These effects may give trouble in standard inductance coils, and may even cause unexpected energy losses in the more important case of the inductive loading coils used on telephone circuits. The authors give a mathematical theory of

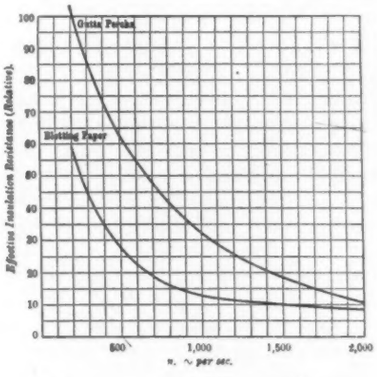


FIG. 3.—INSULATION RESISTANCE.

a leaky induction coil. When the leakage is relatively small the increase in effective resistance is practically proportional to the square of the frequency, and thus the errors due to bad insulation are much accentuated as the frequency rises. Moreover, it is very important to remember that in nearly all insulating materials the effective leakage increases as the frequency is raised, one reason being that the leakance includes the energy due to dielectric hysteresis. The authors give the results of some tests on a length of guttapercha-covered wire placed in water and a small condenser made of blotting paper and tinfoil. Fig. 3 shows how rapidly the effective insulation resistance falls off as the frequency rises. They determined the effective insulation resistance by Wien's method (see abstract below under Units and Measurements).—Lond. *Electrician,* Dec. 10.

Thermo-Electromotive Forces.—J. Weiss and J. Koenigsberger.—The authors have determined thermo-electromotive forces of some metallic oxides, sulphides, etc., against copper. The thermo-electromotive force in volts per degree within the range from 20 deg. C. to 80 deg. C. of silicon against copper is —0.000 44, pyrite +0.000129, graphite +0.0000053, magnetite +0.000055, molybdenite +0.000727. The positive sign means that the current passes from the material to copper at the hot joint. These thermo-electromotive forces are from 10 to 20 times as great as those of metals against copper.—*Phys. Zeit.,* Dec. 1.

Nature of Electricity.—H. Witte.—The conclusion of his article on the attempts which have been made to find an explanation of the nature of electricity. He emphasizes that any mechanical explanation of electrical phenomena must make use of the hypothetical ether and that the latter cannot be assumed to be continuous, but must be supposed to have an automatic structure. In modern physics the attempts to devise such a theory have been abandoned and it seems more rational to try to find an explanation of all physical phenomena on an electromagnetic basis.—*Elek. Zeit.,* Dec. 9.

Units, Measurements and Instruments.

Measuring Insulation Resistance.—A. Campbell and J. L. Eckersley.—In an article on the insulation of inductance coils the authors describe Wien's series-resistance method for determining insulation resistance. The connections are shown in Fig. 4. K is the condenser to be tested, its insulation resistance

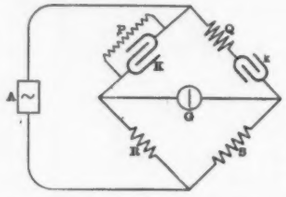


FIG. 4.—DIAGRAM OF CONNECTIONS.

being represented by P; k is a standard condenser with very small (negligible) absorption and leakage, Q is a resistor of adjustable resistance (non-inductive), R and S are proportional arm resistors, the resistance of one of which is adjustable. A is a source of alternating current (for example, a wire interrupter or a microphone hummer), while G is a vibration galvanometer or tuned telephone. By successive adjustments of Q and either R or S the indication of G is brought to zero, in which case

$$K = kS/R\ (1 + \omega^2 k^2 Q^2) \quad \text{and} \quad P = R\ (1 + \omega^2 k^2 Q^2)/S\omega^2 k^2 Q$$

where $\omega = 2\pi \times$ frequency. When testing small condensers it is convenient to use a small air condenser of variable capacity as standard, but even with this it is often necessary to have considerable inequality between the arms R and S. This inequality and other causes tend to introduce considerable error due to the capacities to earth of the various parts of the network. The presence of the error is indicated when, on reversing the connections to the source A, the readings are altered. When the alteration is made, it is usually sufficient to take the mean of the two sets of readings. A better way, however, is to interpose between A and the bridge a special transformer, in which the primary and secondary coils are well insulated from one another, and have between them a guard screen consisting of a coil connected to earth.—Lond. *Electrician,* Dec. 10.

Magnetic Induction in Straight Bars.—C. W. Burrows.—A long illustrated article giving a description of a method of making precision magnetic measurements in use at the Bureau of Standards. A close approximation to uniformity of flux along the test rod may be secured by using properly constructed specimens and yokes and properly distributed magnetizing coils. The double bar and yoke form of magnetic circuit seems to offer the greatest number of advantages and the fewest disadvantages. The reluctance of the yoke and joints should be small. This is accomplished by having the yokes short and of moderately large cross-section, and making the surface of contact between specimens and yoke of considerable area. The corners of the yokes should be rounded off so as to avoid, as far as possible, disturbing end effects. The magnetomotive force may be advantageously distributed in three sections, a uniform solenoid over the test specimen, a second one over the auxiliary rod, and the third section subdivided into four short coils and placed over the four ends of the rods as near to the yokes as feasible. These three magnetomotive forces should be capable of independent adjustment and simultaneous reversal. The test coils to be used as indicators should be long enough to avoid errors due to local irregularities attributable to the inhomogeneity of the rods. One coil should be wound under the middle section of each magnetizing solenoid and the third should be distributed with one-half over each end of the test bar, but not too near to the yokes. In the measurement of the magnetizing force and the magnetic induction these quantities are obtained by zero methods directly from potentiometer readings. As to accuracy, it was hoped at the beginning of this investigation that the magnetizing force required to produce any induction between 1000 and 20,000 gausses might be obtained to within 1 per cent. Investigations now in progress indicate that this accuracy has been secured.—*Bull. Bureau of Standards,* Vol. 6, No. 1, October, 1909.

Iron in Dynamometer Wattmeters.—C. V. Drysdale.—One of the principal defects of the dynamometer wattmeter has been the small torque which is obtainable when the power consumption and shunt reactance of the instrument are kept within suitable limits. This is due to the absence of iron in the wattmeter. An impression seems even now to be prevalent that if iron is introduced into a dynamometer wattmeter in sufficient quantity appreciably to improve the torque, it must necessarily introduce an unallowable amount of error. The author discusses mathematically the effect of iron on the indication of a wattmeter and gives briefly the design of an iron-clad wattmeter devised by himself in which use is made of his theory. The instrument has a phase displacement less than would produce any readable error, and shows the possibility and utility of employing iron in wattmeters. The instrument also appears to give very fair results on direct current and it would, therefore, appear possible to extend the principle to a motor meter of the Thomson form, which should have a much higher torque than is usual in such meters.—Lond. *Electrician,* Dec. 10.

Paper Condenser.—E. H. Weiss.—An article on the design of condensers of tin-plated paper. The author deals with the problem of finding those dimensions for which the capacity becomes a maximum within a given volume.—*La Lumière Elec.,* Dec. 11.

Telegraphy, Telephony and Signals.

Meters.—An official communication of the Reichsanstalt by which a direct-current magnet motor meter (amp-hour meter) of Keiser & Schmidt is admitted for calibration. A description of its construction and action is given.—*Elek. Zeit.,* Dec. 9.

Wireless Telegraphy.—J. Bethenod.—The formula of Bjerknes permits the determination of the damping effect of an antenna of a wireless telegraph system by measurements with a hot-wire ammeter inserted in an auxiliary circuit which

is subjected to the influence of electromagnetic waves emitted by the primary circuit. Independently of Bjerknes, others, like Fleming, have devised various methods. The present author shows how the equations of Bjerknes can be brought into a particular form, so as to further simplify the method of Fleming.—*La Lumière Elec.*, Dec. 4.

Wave Detector.—An illustrated description of the new magnetic wave detector of Rossi, pointing out its great sensibility with respect to the high-frequency currents of wireless telegraphy and its small sensibility with respect to the atmospheric discharges and the currents of other frequencies.—*Elek. Zeit.*, Dec. 9.

Loaded Telephone Cables.—A. W. MARTIN.—The first part of a paper discussing the principles of loading telephone lines with inductance coils.—Lond. *Elec. Review*, Dec. 10.

Miscellaneous.

Berlin Electrical Society.—At the meeting of Nov. 20, 1909, the thirtieth anniversary of the formation of the society was celebrated. The president, Wilhelm von Siemens, gave a brief review of the work of the society during these 30 years. The Siemens-Stephan memorial tablet, which had been founded on the occasion of the twenty-fifth anniversary, was awarded for the first time. Professor Warburg, the president of the Reichsanstalt, was the recipient and made a speech especially on the work of Werner von Siemens. Count Arco then gave an experimental lecture on wireless telegraphy.—*Elek. Zeit.*, Dec. 9.

NEW APPARATUS AND APPLIANCES

The High-Efficiency Ortho-Chromatic Carbon Arc.

BY S. D. GILBERT.

By the process of evolution through thousands of years, the human eye has gradually become accustomed to daylight, or, as it is ordinarily called, white light. Any artificial light is therefore more nearly natural and better adapted to the uses of mankind the nearer it approaches daylight.

By white light is not meant full sunlight, as we comparatively seldom work with objects thus illuminated; it is rather the diffused light made up of sunlight reflected and diffused from the sky and terrestrial objects that must serve as our normal standard of white light. This, of course, varies somewhat from day to day and month to month, but for purposes of comparison a reliably close approximation may be obtained on any fair day.

In comparing the different kinds of artificial light sources now available there is found a startling variation of color, ranging from the deep orange of the flame carbon to the greenish blue of the mercury arc. With the incandescent lamps the color is roughly indicated by the efficiency. All of the lamps of this class give a yellowish light, which becomes more nearly white as the specific consumption decreases. For instance, carbon, Gem, tantalum and tungsten are in the order of their efficiency and also of color, the last mentioned having the lowest figure of specific consumption and being the most nearly white, although it still varies considerably from our standard of white light, as a rough comparison will readily show.

When used to illuminate commercial interiors, especially where colored fabrics are displayed, the selection of an illuminant having the characteristics of diffused daylight is imperative. So many claims for whiteness of light are made for illuminants whose light is obviously tinted that such claims have to some degree been discredited.

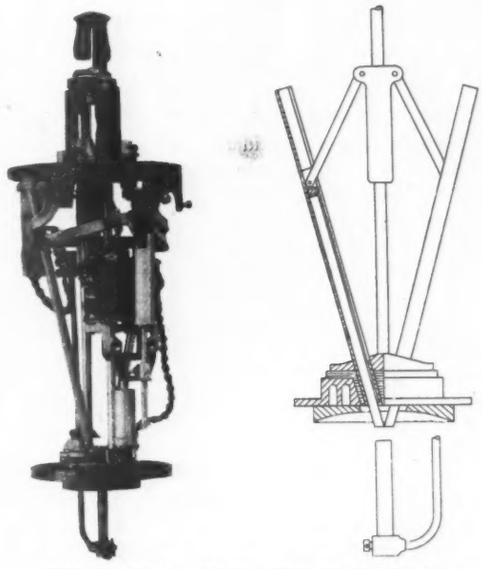
In order to illustrate the superiority of the inclosed carbon arc for color matching and selection, the lumichromoscope and the well-known color booth are available. By these devices the effect of daylight, together with the rays from various artificial sources, can be compared simultaneously, and the superiority of the arc over other artificial illuminants readily observed.

In making comparisons it is imperative that the artificial illuminants be operated at their proper commercial ratings. If gas lamps are to be brought into the comparison, the observer must know that the mantles used are of the commercial type, for by the use of specially prepared mantles, the life of which is extremely short, the quality of light can be improved.

The crater of a carbon arc is very much hotter than the filament of the incandescent lamp, so-called, and at the same time gives a much whiter light. Added to this white crater light there is a small percentage of light from the arc stream proper, in which the waves of blue and violet predominate. This predominance may, however, be eliminated by the use of opalescent glass, which has the property of absorbing more of the blue and violet than of light of the longer wave lengths, and at the same time producing the proper diffusion.

Whenever illuminating requirements are exacting and the selection and matching of colors are of importance, the inclosed arc, when properly equipped, will be found well suited for use.

Fig. 1 represents the mechanism of a new design of arc lamp known commercially as "the intensified arc." It will be noted that the arrangement of its mechanism differs materially from



FIGS. 1 AND 2.—MECHANISM OF ARC LAMP.

conventional designs of inclosed arc lamps heretofore produced. Use is made of two small-diameter (6 mm) positive-cored carbon electrodes, brought into abutment as shown in Fig. 2.

A sliding weight bears upon these converging electrodes, thereby insuring a wedging contact near their burning ends and obviating the necessity of upper holders and flexible current conductors. The arrangement also maintains the arc at a fixed position in the inclosing globe, without the mechanism usually required for maintaining a focusing arc.

The arc is formed and regulated by the movement of the lower negative carbon electrode, which is somewhat larger in diameter (9.5 mm) than the positive electrodes, it having been found that this increase in diameter has practically no effect upon the efficiency and distribution of the direct-current arc. At 5 amp and 80 volts (at the arc) an electrode life of between 75 and 100 hours is claimed by its manufacturers. This life, considering the small diameter of the positive electrodes, is made possible by the use of the abutting principle referred to above.

The principal advantages derived from the use of small positive electrodes are efficiency and steadiness of operation. Al-

though in the intensified arc lamp two positive electrodes are used, they are burned alternately. At 5 amp, therefore, the current density is relatively high, and as the heat cannot pass off by conduction, as in the larger electrodes, the end of the electrode is maintained at a high state of incandescence. Under such operating conditions the end of the positive electrode is apparently in the area of the crater, thus preventing the wandering of the arc and insuring high efficiency and steady operation.

FIGS. 3 AND 4.—EXTERIOR VIEWS OF ARC LAMPS.

The lamp when equipped with a clear inner globe (no outer) and small metal reflector is said to have a specific consumption of about 0.6 watt per maximum radial candle. By maximum radial candle is meant the average candle-power at the maximum angle, as shown by plotting a curve of average distribution in a vertical plane; using the same equipment and expressing the specific consumption in watts per mean hemispherical candle-power, a figure of 0.91 is obtained. This low initial consumption readily admits of the use of diffusing globes adaptable to specific installations.

It may be safely stated that in the past many artificial illuminants of inferior characteristics have been selected by reason of the artistic effect of the installation, rather than for correct illumination. With the advent of the so-called intensified arc lamp, a unit of artistic design embodying the requirements essential to modern high-class illumination is available. It is evident, however, that no one design and finish of casing will harmonize with all of the various periods of architectural construction, and variety of designs and finishes suitable to meet the demands generally imposed must be produced. Where the requirements are most exacting individual designs harmonizing with the interiors to be illuminated shall be used.

It would seem that in the intensified arc lamp there is embodied the features desirable for both the esthetic and the economical illumination of commercial interiors.

"Beehive" Reflector.

The National X-Ray Reflector Company, of Chicago, has brought out a new reflector for large tungsten lamps which is called the "Beehive" on account of its resemblance in shape to the old-fashioned beehive. This reflector was designed specifically for the lighting of the track room of the Northwestern University gymnasium at Evanston. This is a very large interior, with lamps placed from 30 ft. to 40 ft. above the floor. Mr. J. R. Cravath, illuminating engineer for the gymnasium building, wished a reflector which would give an efficient distribution of light from 100-watt tungsten lamps placed at this height and which would at the same time shade the direct rays of the lamp from the eye of anyone looking the length of the room. He designed this reflector to accomplish this purpose for this particular case and the manufacturers have since placed it upon the market for general use in the lighting of large interiors where opaque reflectors are desirable. It has the usual corrugated mirror reflecting surface, and is of one piece of glass, as are all reflectors of this make.

The distribution of light from this reflector with a 100-watt

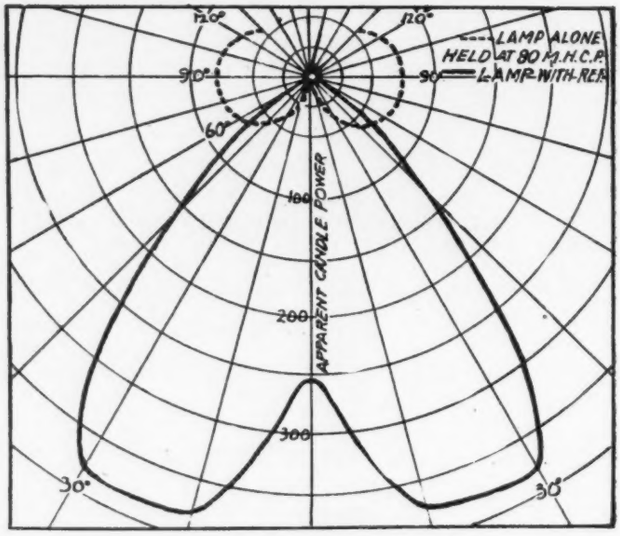


FIG. 1.—LIGHT DISTRIBUTION OF "BEEHIVE" REFLECTOR.

tungsten lamp operated at 80 mean horizontal candle-power is shown in Fig. 1. The shape of the reflector is shown in Fig. 2. Its total depth is 11⅝ in. As will be seen from the distribution curve, this reflector with a 100-watt tungsten lamp will give a fairly even illumination over a surface extending 30 deg. from a vertical line through the lamp axis. With a 250-watt tungsten lamp, the area lighted is increased to 45 deg., but the shading of the lamp by the reflector is, of course, not so complete.

The special field for this type of reflector is in the lighting of factories, gymnasium rooms, foundries and other places where it is desirable to place the lamps high out of the range of vision and at the same time obtain high efficiency and shade the lamps so that ordinarily no direct rays from the lamp will enter the eye.

An analysis of the distribution curve shown in Fig. 1 brings out the fact that the mean candle-power between the vertical

FIG. 2.—"BEEHIVE" REFLECTOR.

and 60 deg. from the vertical (which is practically the entire range of the reflector) is 131.1 cp, giving 610 lumens. With a lamp consuming 100 watts, this would give lumens per watt equal to 6.1 and watts per lumen 0.164. In other words, with the lamp and reflector clean, as under test conditions, an average illumination within the range of the reflector of 1 foot-candle could be obtained with an expenditure of 0.164 watt per square foot without regard to the color of ceilings or walls. For locations where ceilings and walls are dark and have little reflecting power, this type of reflector is, therefore, well adapted and gives high efficiency. With light ceilings and walls more diffusion than is obtained from an opaque reflector of this kind is desirable. Where the room to be lighted with opaque reflectors of this kind is large, a sufficient number of lamps can be used so that shadows are not annoying.

Combination Electric Heater, Cooker and Toaster.

The new combination heater, cooker and toaster shown in the accompanying illustration is being marketed by the Central Electric Company, of Chicago. As will be seen from the illustration, the heater is provided with a rectangular metal frame, which not only serves to embody the heating element, but also forms a chamber in which is located a little toasting oven in the shape of a drawer. In this little oven the bread is toasted

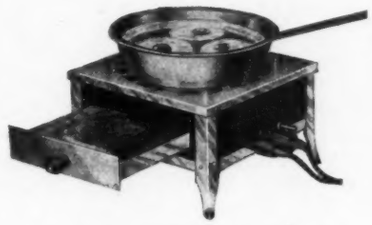


FIG. 1.—TOASTING DRAWER OPEN.

by the evenly distributed heat radiated downward from the heating element. The construction is such that any of the ordinary cooking utensils may be used upon it. It is built to combine mechanical strength with electrical durability along lines that

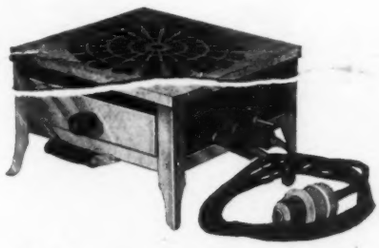


FIG. 2.—TOASTING DRAWER CLOSED.

experience has shown to be most economical and satisfactory for articles to be used by persons inexperienced in the handling of electrical devices.

The heating units, composed of special non-oxidizing alloy, are spiral in shape and of such construction that they can be readily renewed without the use of tools other than a pair of pliers. A mica strip running lengthwise of each heating unit serves as a support for every convolution of wire, thus preventing any possibility of short circuits. A three-contact switch is provided, which enables low, medium and high heats to be secured, thus insuring a minimum consumption of energy.

The new heater is designed to appeal to those who would prefer to prepare light meals by electricity, but who find that a sufficient selection of heaters, toasters and special utensils is discouragingly expensive, and also to those living in hotels or apartments where space is at a premium and gas not easily accessible, who enjoy having a dainty midnight luncheon after an evening at the card table, when it is possible to do so without destroying the effect of the evening's entertainment.

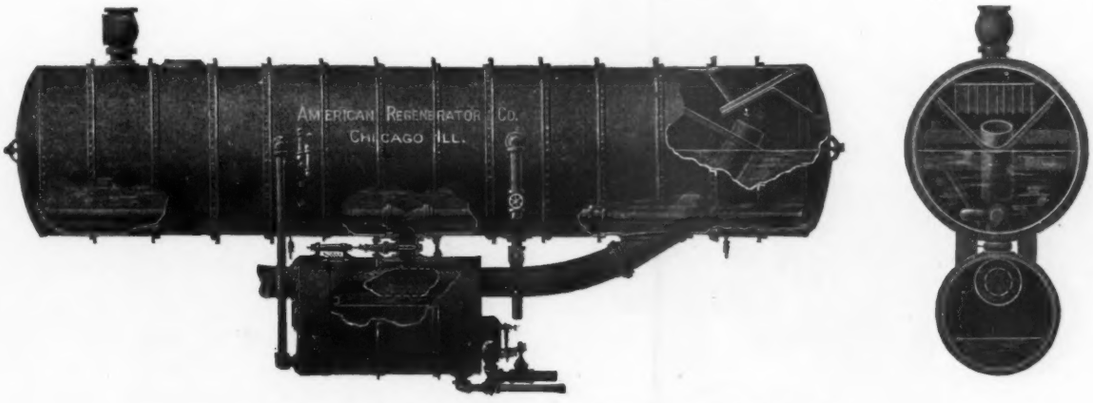
Steam Regenerator.

The steam regenerator shown in the accompanying illustration is intended for use in connection with a combination reciprocating engine and steam turbine plant. It acts to store the energy of the exhaust steam from the reciprocating engine, to be supplied as needed by the steam turbine.

The regenerator is so designed that each particle of steam entering the apparatus comes into contact with many times its own weight of that portion of water at the lowest temperature, and since the hottest water is delivered on the surface of the water in the regenerator, the circulation is excellent and all the contained water is effective.

Referring to the illustration herewith, the water from the larger tank falls through a pipe containing a valve into an annular space surrounding the perforated spray pipe through which the exhaust steam from the engine enters at the left. In entering the lower chamber the exhaust steam operates a vane, which in turn controls a valve in the pipe connecting the upper and lower chambers; thus the amount of water supplied to the outside of the spray pipe is always proportioned to the amount of exhaust steam passing through it. In this manner the steam comes into thorough contact with every particle of the water, so that the water is heated to the full temperature of the exhaust steam. The momentum of the steam is sufficient to carry the mixture of water and steam up through the eduction pipe into the upper tank, where the mixture is delivered against suitable baffles and separated from the steam.

A steam regenerator can be employed to advantage in a number of cases, namely: (1) where the output of steam by the engine is intermittent or fluctuating and the requirements for steam by the turbine are uniform; (2) where the engine and the turbine supply power to the same busbars through electric generators, so that the loads on the generators vary in conjunction with each other; (3) where the engine delivers steam uniformly, but the turbine load fluctuates; (4) where the output of steam by the engine is intermittent or fluctuating and the requirements for steam by the turbine are independently intermittent or fluctuating also.



SIDE AND END SECTIONAL ELEVATIONS OF REGENERATOR.

The use of a regenerator in each of the above cases serves to smooth out the variations between the momentary discharges of the reciprocating engine and the demands of the steam turbine. The regenerator is to the steam turbine-reciprocating engine combination what the storage battery is to the electrical circuit, or the flywheel is to the reciprocating engine. The regenerator herein described is built by the American Regenerator Company, Chicago, Ill.

Walpole Tapes.

In connection with the development of its already extensive line of insulating materials the Massachusetts Chemical Company, of Walpole, Mass., has had exceptional opportunity to study the effect of a wide variety of materials and processes upon the strength, durability, adhesiveness, insulation and other qualities of insulating tape, and as a result has placed on the market a new tape known as Walpole tape. This tape is packed in 80 ft. lengths, ¾ in. wide, in round tin boxes. It is made upon a strong fabric, manufactured expressly for this purpose, thoroughly impregnated with a special compound claimed to have remarkable qualities of insulation, adhesiveness and resistance to atmospheric action. Under many tons pressure this compound is rolled into the fabric, filling every pore, crowding between the fibers, closing the most minute pinholes, and providing an absolutely impervious coating upon each side of the fabric. The friction is noticeably smooth. The result is perfect protection from the elements and as a consequence, enduring strength. The composition of the compound keeps it constantly "tacky," without variation under extremes of temperature, and amply adhesive for all requirements, but not so much so as to interfere with easy handling. The compound contains nothing that will corrode copper or in any way affect the materials with which it may come in contact.

The tin box in which Walpole tape is packed makes it distinctive. Although the guarantee upon this box specifically covers only one year, it is stated that the tape will retain its superior qualities for years, no matter what the climate or the altitude. The box preserves any unused portion of the roll and is in itself an inducement to care and economy in the use of the tape.

Motor-Driven Meat Chopping Machine.

An example of the simplicity, convenience and efficiency of the electric motor drive is the application shown in the illustration, a 10-hp alternating-current motor gear-connected to a large meat chopper. This machine has a capacity for cutting

MEAT CHOPPER.

and recutting 1500 lb. of beef three times per hour, and 3000 lb. of pork twice per hour. The compact drive secured by mounting the motor on the chopper frame has the added advantage of lifting the electrical equipment above the floor, always wet and more or less greasy in a sausage room. Besides the protection from dirt and grease thus afforded the motor windings and parts, virtually no space that is occupied by the driving apparatus.

The improved sanitary conditions, as well as efficiency, secured by avoiding moving belts and shafting are important results of employing electric drive in the preparation of foodstuffs. The self-contained construction of the present application prevents the stirring up of dust or foreign particles in the chopping room. Gear drive has also worked a considerable economy in operation, for while the type of machine illustrated ordinarily requires 10 hp when belt-driven, it has been found to take only 7½ hp with the spur transmission shown. This economy of power, as well as the low cost of the installation, is perhaps the strongest point in favor of this method of applying electric power, although the convenience, compactness, simplicity and cleanliness of this drive should not be overlooked.

The machine illustrated is a No. 66 Enterprise chopper, and was equipped with a Westinghouse three-phase induction motor for the Ziemsen Butchers' Supply Company, Chicago, Ill.

Conduit Bender.

The universal bending machine shown in the accompanying illustration is well adapted for use as a conduit bender for use

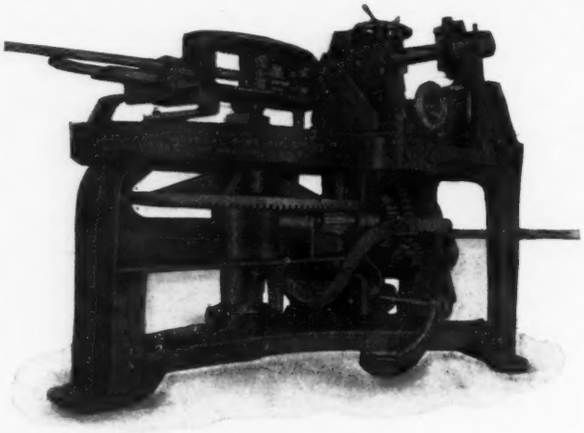


FIG. 1.—SIDE VIEW OF BENDING MACHINE.

by wiring contractors. Some idea of the constructive details and methods of use can be gained from Fig. 2. By means of adjustments in various planes the pipe or conduit can be bent

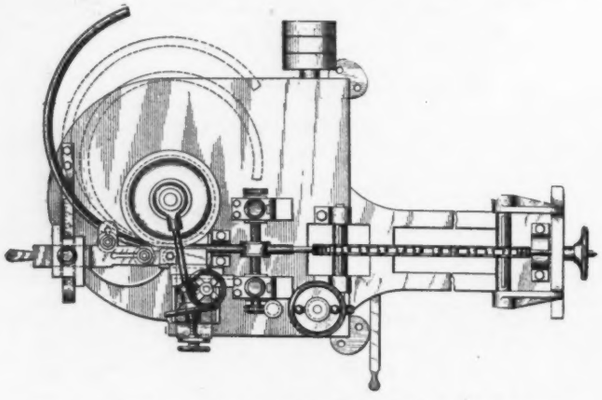


FIG. 2.—VIEW OF TOP OF MACHINE SHOWING RADIAL BENDS.

into any required size or shape, while with proper attachments the machine produces bends automatically. This machine has been placed on the market by J. Fillmore Cox & Company, Bayonne, N. J.

Electric Furnace Demonstration Room in Chicago.

The Hoskins Manufacturing Company, of Detroit, has opened a demonstration room in connection with its Chicago branch office at 321 Dearborn Street, where the actual operation of the company's various electric furnaces and heating appliances is shown. By means of an installation of pyrometers, the temperatures attained by the various devices are also indicated. The series of five furnaces illustrated on the right in Fig. 1 include a crucible, tube and three sizes of muffle chamber styles, all designed for operation on standard 110 or 220-volt circuits. The crucible form *A* is used in a variety of chemical work, such as making incinerations and fusions. The tube chamber furnace *B* is specially adapted to use in steel laboratories for the determination of carbon in steels by what is known as the direct combustion method. The muffle furnaces of this type, *C*, *D* and *E*, cover a wide range of uses in the manufacturing arts, such as for hardening carbon steels, annealing small metal parts, and enameling, as well as for chemical and optical works. Behind each of these furnaces is a rheostat which is used to control the current, and hence the temperature.

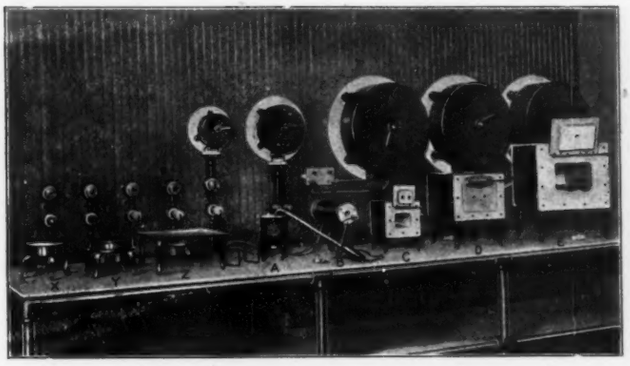


FIG. 1.—HOT PLATES AND ELECTRIC FURNACE.

A crucible and tube-chamber furnace of a different type are shown at *A* and *B*, Fig. 2. This type of furnace is designed to operate at very low voltage, with a high current. The resistance element is of the same patented alloy as is used in the furnaces *A* to *E*, Fig. 1, only of much larger cross-section. This makes possible a higher temperature than can be obtained in the standard-voltage type. The transformers necessary to step the line tension down to the required point, together with the rheostats for controlling the temperature, are shown immediately below the furnaces. The crucible furnace, *C*, Fig. 2, has a patented carbon plate resistance element. This furnace is used for melting gold and metallic alloys. It operates on a low voltage with a high current density, and the transformer is shown immediately behind it.

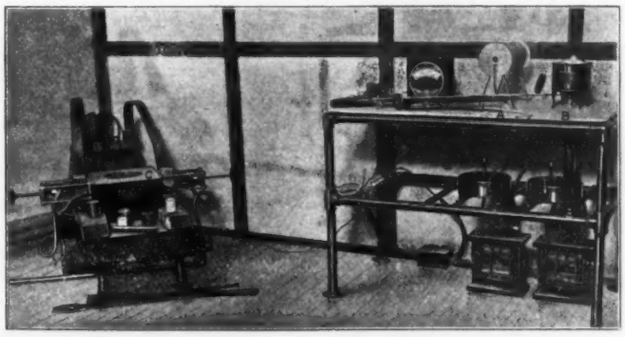


FIG. 2.—CRUCIBLE AND TUBE FURNACES.

A tube chamber furnace of this type is shown at *C*, Fig. 3. The furnace is mounted directly over the transformer. The hose connections shown are for a circulation of water, which is necessary to cool the terminals. This furnace is used for welding tubing and for other allied operations requiring the high temperatures it produces. Two different types of electrically heated hot plates are shown at *Y* and *Z*, Fig. 1. These plates operate on standard-voltage circuits, and are used for a variety of laboratory work.

The installation of thermo-electric pyrometers is a feature of the display. A thermo-couple is shown inserted into the crucible furnace *A*, Fig. 1. The leads of this couple connect with the large illuminated dial meter in the center of the switchboard. This meter is graduated to read directly in degrees Fahrenheit, and it indicates temperatures as high as 2550 deg. By means of an eight-point switch immediately below it, any one of eight thermo-couples which may be located in different furnaces can be connected to the meter. These products should interest engineers and central-station managers, since they open a field for the application of electric energy to heat production for a variety of industrial purposes.

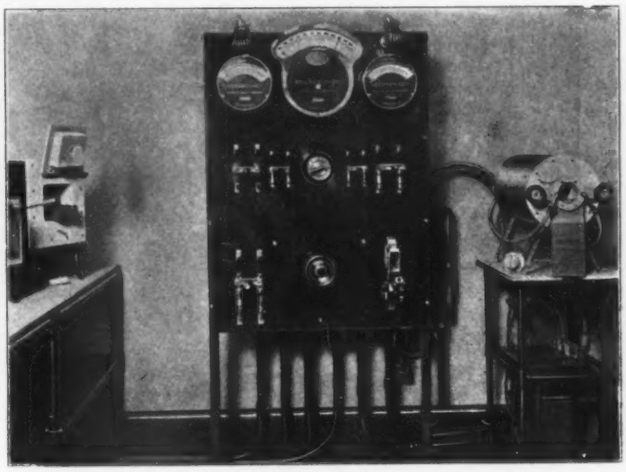
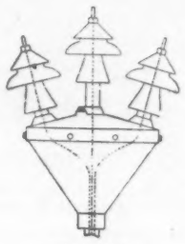


FIG. 3.—SWITCHBOARD WITH PYROMETER AND FURNACE.

Weatherproof High-Tension Pothead.

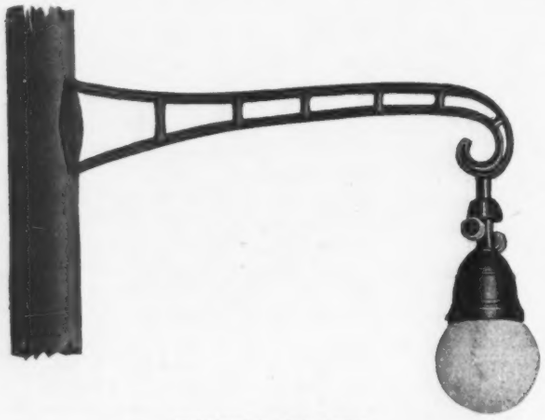
A new type of outdoor pothead for use in connecting between high-tension, overhead lines and lead-covered cables is illustrated herewith, and has been placed on the market by the Central Electric Company, Chicago, Ill. The pothead is of weatherproof construction and designed to be mounted on a cross-arm or pole, so that it is applicable for connecting high-tension transformers to underground distributions. The porcelain insulators have a continuous passage in which is located a hollow steel pin lined with treated wood. Means are also provided for effectually sealing the insulator cones against the entrance of moisture. The supporting case of the pothead is of iron or aluminum, as desired, and is provided with a metal chamber arranged to be filled with insulating compound. As will be seen from the illustration, the lead-covered cable enters from the bottom of the chamber and the three high-tension lines leave at the sealing cones of the insulators.



POTHEAD.

Tungsten Arc.

The Philadelphia Electrical & Manufacturing Company, Philadelphia, Pa., has recently put on the market a new lamp known as the "Tungsten Arc." These lamps are designed to take the place of gas arc lamps and are adapted for interior and window lighting, as well as for street lighting. It is claimed for these lamps that they are in many respects superior to the ordinary

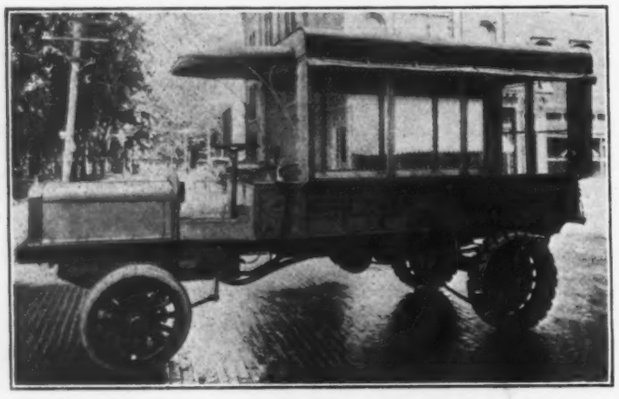


TUNGSTEN ARC LAMP.

enclosed arc lamp, as there is an absence of all shadows, the light is steady and uniform in color; the lamps are safer and much cleaner, no trimming is required, and especial attention has been given to getting the best possible distribution of light. In connection with these lamps this company is also manufacturing an extensive line of ornamental brackets, one of which is shown in the accompanying illustration. This bracket has an extension of 3½ ft., and while the weight is but 18 lb., it is rigid and stiff.

Gasoline-Electric Express Wagon for Suburban Service.

The Champion Wagon Company, of Owego, N. Y., is the builder of the gasoline-electric express wagon intended for suburban service and illustrated herewith. Vehicles of this type possess all the merits of individual gasoline and electric machines, combining the economy of a gasoline prime mover with

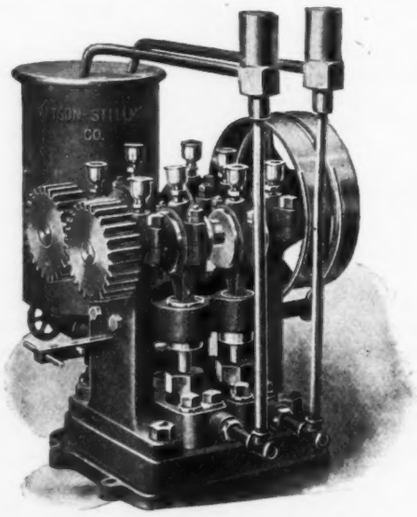


GASOLINE-ELECTRIC EXPRESS WAGON.

the advantages of electric drive and control. A four-cylinder gasoline engine is direct-connected to a 7.5-kw compound-wound generator rated at 50 amp, 125 volts. The engine and generator are mounted on a subframe in front of the wagon under the hood. The subframe has a three-point suspension, the rear end being a pivoted support. Inasmuch as the generator has but one end bearing, the armature being bolted to the engine flywheel, a very compact set results. All the valves of the engine are on one side; the oiling system is self-contained in the crankcase, and is supplied from the sump below the crankcase, which holds about 2 gal. The generator is designed to withstand momentary overloads as high as 200 per cent without sparking. Unlike some combination machines, the controller is used only when starting and stopping the car, speed variations being obtained by using the spark and throttle lever. The controller is placed in circuit on very low voltage, and as the car starts the engine speed is gradually increased and the vehicle brought to running speed without shock or jar. While the controller is in circuit the voltage may be reduced and the brakes applied to slow up or to stop the car without stalling the engine. The brakes are of the internal expanding type, faced with an asbestos lining. The normal rating of the motor used in driving the vehicle is 40 amp, 85 volts, and there is a double reduction between the motor and the wheels; a Morse chain is used between the motor and the countershaft, and a roller chain between the countershaft and the driving wheels. Motor, generator, countershaft and hubs are equipped with annular ball bearings so as to minimize friction, and speeds ranging from 1 to 16 miles per hour are obtainable, the average speed of the wagon, loaded, being 12 miles per hour. The carrying capacity of the vehicle is 3.5 tons.

Multi-Service Hydraulic Pump.

The four-cylinder, two-pressure, line hydraulic pump illustrated herewith represents a type by means of which one, two, three or four pressure lines may be served independently of each other, but from a common reservoir. Each pressure line has a separate pressure chamber, safety valve and release line, and is served by a separate pair of cylinders having eccentrics



MULTI-SERVICE HYDRAULIC PUMP.

set to give a continuous flow. Any pressure up to 600 lb. per sq. in. may be delivered into any line, the limit in each instance being determined by the setting of the safety valve, which opens as the pressure tends to exceed the limit and lets the surplus liquid pass back through the release pipe to the reservoir. Any pressure line can be thrown out of service entirely by opening the safety valve, in which instance all the liquid in that line pumps directly back to the reservoir.

The one, two, three and four-pressure line pumps are practically identical in design save for change in the length of the bedplate and the shafts to accommodate the required number of pressure chambers, cylinders, piston rods, eccentrics, etc., and may be fitted with an electric motor instead of the pulley shaft shown. These pumps are made by the Watson-Stillman Company, of New York.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.

The condition of trade during the past week showed further progress and expansion. For the most part, weather conditions have been favorable to a liberal holiday trade, and from almost every section of the country the reports of the retailers are that the Christmas business has been entirely satisfactory. Except in the Northwest, where the strike of the switchmen has to some extent restricted transportation, there has been a large movement of goods. In some sections the country roads have been in such condition that the farmers have been unable to visit the county towns, but in all of the smaller cities, however, reports indicate that retail trade has been better than since 1906. As far as jobbers and wholesalers are concerned, there has been little new business booked. This is true of the pre-holiday season every year. There have been, however, quite a number of re-orders received, and in many instances there have been demands for rush shipments, indicating that the retailers have sold more goods than was anticipated when they made their original purchases. There is continued expansion in the industrial world. The iron and steel business goes on with the same tremendous amount of activity that has been in evidence for several months. The electrical industries all report better sales, especially in smaller apparatus. The woolen manufacturers and the boot and shoe makers are all busy. In the cotton industry alone there is some contraction, owing to the unusually high price of raw material and the necessity of marking up the price for finished products. Collections for the past fortnight have been rather dull; this, however, is always to be expected at this season. Failures for the week ended Dec. 23, as reported by *Bradstreet's*, were 264, as against 273 the previous week, 196 in 1908, 248 in 1907, 161 in 1906 and 212 in 1905.

THE COPPER MARKET.

There was considerable activity in the copper market during the few days just before the holidays, although the buying by consumers was rather small. The exporters were in the market and purchased quite liberally for February and March deliveries, together with moderate purchases for January shipment. The prices ranged from 13½ to 13⅝ cents f.o.b. for electrolytic. The activity has been considerably stimulated by what appears to be the more favorable statistical position as to copper metal. It was estimated that deliveries for the month into domestic consumption will be upward of 60,000,000 lb., while deliveries for export may be in the neighborhood of 70,000,000 lb. It is claimed, also, that there has been a decrease in the output of refined copper during the month, due not only to the holidays but to the fact that the daily rate of production will show a slight decrease. All of these things lead to the expectation of a marked falling off in the surplus stocks when the next report of the Copper Producers' Association is made public. Of course, it is understood that the actual consumption of copper is still far below the actual production, but conditions at the present time are more favorable to speculation, and it seems that there are always enough speculators to take hold at every opportunity. Exports for the current month, including Dec. 27, have been 22,499 tons. The daily call on the Metal Exchange Dec. 27 quoted standard copper as follows:

	Bid.	Asked.	Selling price.
Spot	13.12½	13.37½	.....
December	13.25	13.37½	13.32½
January	13.25	13.37½	13.32½
February	13.25	13.37½	13.32½
March	13.25	13.37½	13.32½
April	13.25	13.37½	13.32½

The London prices Dec. 24 were as follows:

	Noon. £ s d	Close. £ s d
Standard copper, spot	60 15 0	*.....
Standard copper, futures	61 7 6	*.....
Market	Firm	*.....
Sales of spot		1,600 tons
Sales of futures		1,000 tons

Extreme fluctuations for this year:

	Highest.	Lowest.
London spot	£64 2 6	£54 12 6
London futures	64 17 6	55 10 0
Standard	13 45	12 12½
London, best selected	67 15 0	59 0 0

THE "MAZDA" METALLIC FILAMENT LAMP.—A metallic filament lamp will be placed on the market at the beginning of the year by a number of lamp companies under the trade name of the "Mazda" lamp, the distinctive word apparently being drawn from Zoroastrianism and signifying "light." The technical difference between the "Mazda" and tungsten filament lamp has not yet been divulged.

CALIFORNIA LAMP FACTORY.—Negotiations by the National Electrical Lamp Association for the purchase of a block of land in West Oakland lying between Peralta and Campbell and Sixteenth and Seventeenth Streets, have been completed. It is the purpose of the company to erect a large factory on the new site.

CENTRAL STATION DEVELOPMENT COMPANY.—The Central Station Development Company, of Cleveland, Ohio, has been organized for the purpose of co-operating with central stations in developing commercial departments. The work of the company will be based upon methods used by its vice-president and general manager, W. H. Wissing, in the development of the new business department of the Union Electric Light & Power Company, of St. Louis, Mo., which work attracted at the time much attention in central station circles throughout the country. The aid to be rendered to central stations will be quite wide in scope, including a complete system for the organization of new business departments, including forms, index cards, etc., and specific plans for new business campaigns. In addition, central stations will be instructed as to well-tried means of locating prospects and securing the co-operation of dealers and contractors. As above stated, W. H. Wissing, who is general manager of the Tungstolier Company, of Cleveland, will be general manager of the Central Station Development Company. E. J. Kulas, president of the Tungstolier Company, is president of the new company, of which T. M. Roche is secretary and field manager. These gentlemen are assisted by a staff of 10 practical men with central station commercial experience.

AUTOMOBILE INDUSTRY EXPANDING.—According to the statistics of the American Motor Car Manufacturers' Association, there were actually made and sold in this country during 1909 more than 82,000 cars of various types. This is an increase of about 50 per cent over the previous year, and the value of the product was $98,400,000. It is estimated by the same authority that there will be built during 1910 at least 200,000 cars which will be worth something like $240,000,000. At present there are about 275,000 cars in private ownership in this country or one for every 175 of population. These cars are estimated to be worth more than $400,000,000. It is said that the chief drawback to the expansion of the automobile industry is the enormous increase in the cost of tire material. Only the best grade of Para rubber can be used in the manufacture of automobile tires, and the price of this material has more than doubled in the past 18 months. Not only that, but the supply of rubber is not sufficient to meet the demands of the tire makers.

OTIS ELEVATOR COMPANY.—In common with all other industrial concerns, the Otis Elevator Company has experienced something of a boom within the past 12 months. The fiscal year of the company is the same as the calendar year and it is estimated that the earnings for the current year are likely to be considerably in excess of those for 1908, which were $832,772. Many of the contracts taken by the company require a considerable time for execution, and for that reason the full effects of the business booked during the past year will not be felt until well along in 1910. All of the plants of the company are in excellent shape and are running at full capacity. During the year, a new foundry and warehouse have been added to the Yonkers plant and an addition to the manufacturing end of the same plant is being constructed.

THE DUKES IN COTTON MILL DEVELOPMENT.—There is a persistent report afloat in the Piedmont section of North Carolina that the Duke interests are backing a tremendous proposition which looks to the erection of 21 of the largest cotton mills in the country, to be located at various points on the transmission system of the Southern Power Company. The Dukes are practically the owners of the Southern Power Company, which is a $10,000,000 concern, and which operates a number of hydroelectric stations in both North and South Carolina. It is now reported that these interests propose to establish a string of big mills, which will become customers for the energy generated by the Southern Power Company. Some weeks ago it was announced that an organization had been formed with $500,000 capital to construct a cotton mill at Great Falls, S. C. This is the site of one of the Southern Power Company's largest generating plants, and this is believed to be the beginning of the project. The Southern Power Company has recently taken over Lookout Shoals in Catawba County, North Carolina, and will construct a plant there. The big plant at Ninety-nine Islands, South Carolina, will be completed in April. The dam at this site is 75 ft. high and 1500 ft. long. It has also been stated that the Southern Power Company would likely take over the Whitney plant near Salisbury, N. C. The Southern Power Company has been for years doing all that it could to induce manufacturers of all classes to establish their plants along its lines. It is estimated that when all of the sites the company now owns are developed it will have 200,000 hp for market.

EXCELLO LAMPS FOR NEWARK.—The Market Street Business Men's Improvement Association, of Newark, N. J., and the Public Service Corporation of the same place have decided to use 58 pairs of "Excello" flaming arc lamps for lighting the business section of the city. These lamps are to supplant other lamps, and each pole will bear one pair of lamps. Already 16 pairs of these lamps have been delivered, and the others will be furnished as rapidly as the Excello company can secure the lamps. This is part of the movement on the part of Newark business men to make the city more brilliant. The Excello company reports that the demand for its flaming arc lamps has been very brisk within the past few months. One order recently received was from the Nichols Copper Company, of Brooklyn, for 100 lamps to be installed in its Laurel Hill plant.

NEW PLANT OF DETROIT FUSE & MANUFACTURING COMPANY.—The Detroit Fuse & Manufacturing Company, Detroit, Mich., has just completed the erection of a new factory building in Detroit for the manufacture of "Arkless" enclosed fuses and Detroit iron-clad switches. Motors aggregating 70 hp furnish the power, and among the features of the factory are a finely equipped tool department for the manufacture and maintenance of special tools and dies; an electrical laboratory for testing fuses and for experimental and development work, and a drafting department for work in connection with the Detroit line of iron-clad switches. The new building greatly enlarges the manufacturing facilities of the company, which have become too small for its growing business in fuses and switches.

IDAHO POWER & TRANSPORTATION COMPANY.—Since the purchase by the Idaho Power & Transportation Company, of Idaho Falls, of the property of the St. Anthony Light & Power Company, which was referred to in our issue of Nov. 25, extensive plans for development have been formed. The St. Anthony Company was furnishing the light and power for Rexburg, Teton City, Sugar City, Salem and St. Anthony. All of these cities are now furnished with energy from the plant at Idaho Falls, and the smaller plants at St. Anthony and Teton City are being used as auxiliaries. The company has put in two more units at its central station near Idaho Falls of 600 kw each, and expects to be able to keep up with the demand for power in its immediate section. It has now about 75 miles of transmission lines.

CHEAP POWER FOR ZACATECAS MINES.—The Cia. Electricia de Zacatecas, which supplies the city of Zacatecas, Mexico, with light and power, has made an application to the State authorities for a modification of its present charter and franchise which will enable the company to increase its service and extend the field of its operations. It asks permission to build transmission lines into neighboring towns in order to supply them and various mines with power. If this permission is granted it will largely increase its generating plant. The mines in this section have always been handicapped by the high cost of power. It is claimed that with intelligent management and with cheap power, these mines can be made very profitable.

ELECTRIC POWER FOR EDMONTON, CANADA.—For some time past engineers have been engaged on a project to secure power from the Saskatchewan River, and, after a thorough investigation of the upper stretches of the river, a point 110 miles distant from Edmonton has been decided upon. Charles Tupper, B.Sc., of McGill University, son of Sir Charles Hibbert Tupper, and Charles H. Colgross, M.E., have been conducting the investigations. The estimated cost of the project will be about $1,500,000, and the minimum power that can be developed is approximately 20,000 hp. It is expected that Montreal capital will become associated with the local interests who are identified with the project.

GREAT IMPROVEMENT IN CONDUIT BUSINESS.—The demand for underground conduit has improved very materially during the latter half of 1909. Conditions now are practically normal. "We have had a very satisfactory year," said B. S. Barnard, of the Standard Vitrified Conduit Company, in discussing the conditions of trade. "Our business has been very good, and the demand for our product is constantly increasing. If we do all the business next year that the present indications promise, we will have the best year in the history of the company. Of course, the winter is the off season for underground work, but there is so much development work in prospect that we expect to be busy by the first of March."

NO CONSOLIDATION OF TECHNICAL JOURNAL PUBLISHING COMPANIES.—An article printed last week in a New York City daily newspaper and reprinted in other newspapers, gave a circumstantial account of an alleged consolidation of several companies publishing technical journals, the McGraw Publishing Company, publishers of the *Electrical World*, being included in the list. The story had absolutely no foundation, present or prospective, so far as relates to the publishers of the *Electrical World*; and we are informed by the other publishers mentioned that the article is similarly without truth in its references to them.

ELECTRICAL CONSTRUCTION.—Among the items printed under Construction Notes in our present issue are announcements of proposed new plants or considerable extensions of present plants as Sheboygan, Wis.; Johnstown, Pa.; Kimball, Va.; Goldstone, N. C.; Stillwater, Okla.; Erwin, Tenn.; Jourdanton, Tex.; Highbridge, Ky.; Millersburg, Ky.; Baltimore, Md.; Granite Falls, Minn.; Lafayette, Ga.; St. James, Mo.; Sylvan Beach, N. Y.; Lainsburgh, Mich.; Santa Barbara, Cal.; Marion, Kan.; Marion, Ia.; Logan, Utah, and Evansville, Wis.

MOORE ELECTRICAL COMPANY.—The Moore Electrical Company, of Newark, N. J., reports a large demand for the Moore tube light. These tubes are especially being used in the various silk manufacturing concerns and dye works in the eastern section of New Jersey. It is claimed that the light which they give is perfect for matching colors. Among the recent purchasers of tubes are the United Price Dye Works, of Lodi, N. J., and Formann, Stumpf & Sharpe, of Paterson, N. J.

TUNGSTEN CONCENTRATES.—The Primos Mining Company, Boulder, Col., is building a new mill which, it is stated, will have an annual capacity of more than $250,000 in tungsten concentrates. The Primos company also will build a hydroelectric plant of 2500 hp, of which 500 hp will be used in its mines and mills and the remainder sold to operators in the Boulder district.

DUPLEX METALS COMPANY.—Officials of the Duplex Metals Company declare that there has been quite an active demand for copper-covered wire within the past few months. This demand has been largely for signal and telephone work and for use on railroads. It is claimed that the use of this kind of wire is broadening out and that it is becoming available for new purposes all the time.

EQUIPMENT OF TOKYO ELECTRIC LIGHT COMPANY.—We are informed that, with the exception of the generators, all of the equipment of the plant of the Tokyo Electric Light Company, which was described in our issue dated Dec. 16, was furnished by the General Electric Company.

UNITED SERVICE COMPANY.—There has recently been organized under the laws of New York the United Service Company, with a capitalization of $100,000. This company will have its office at 40 Wall Street, New York. It has been organized for the purpose of dealing in supplies of all kinds, especially equipment and other material necessary to the operation of electric railways, electric light companies, gas and water companies. It will also do the purchasing for the subsidiary companies of the Susquehanna Railway, Light & Power Company. The company will take over, dating Jan. 1, the entire business of the Railways Equipment Company, which has been operating in a similar line. The officers are: S. J. Dill, president; Henry Morgan, vice-president; A. V. Wainwright, secretary; W. D. Martin, treasurer; F. G. Robinson, purchasing agent.

Financial Intelligence.

THE WEEK IN WALL STREET.

In spite of the fact that the volume of business, both in railroad and industrial enterprises, is continuously increasing, and that there is every reason why the Wall Street market should be strong, the past week was one of particular dullness and inactivity. Trading was listless during the days that preceded the holidays, and the general tendency of prices was to sag. There was no definite movement, however, of importance sufficient to cause any sharp breaks. The general condition of stagnation is well illustrated by the fact that the average net change for the week of 20 of the most active railroad and industrial issues was less than one point. There are still many speculators who are expecting the traditional year-end rise, and who believe that the rather heavy profit-taking by dealers who wanted money for Christmas is responsible for the postponement of this advance. In many directions there should undoubtedly be advances recorded. Quite a large number of prominent railroads and industrial concerns have advanced their rates of dividends, and earning reports are encouraging from almost every source. One of the big features of the week was the remarkable flurry in Rock Island common, which occurred shortly after the exchange opened Dec. 27. Within a few minutes the stock advanced from 50 to 81, a storm of buying orders having suddenly appeared upon the floor. Almost as suddenly the buying ceased and the stock reacted, closing at the end of the session only 1¾ points above the close Friday, Dec. 24. As this little flurry was not accompanied by any reports of deals or dividend increases, it was generally taken as a manipulative movement by a party of speculators, who in some manner slipped a cog in their program. The feature of the money market during the past week was the sudden advance at one period of call money to 6 per cent, then the reaction to normal rates. Quotations Dec. 27 were: call, 4¾ @ 5½ per cent; 90 days, 4½ @ 4¾ per cent. The quotations in the table are those of the close, Dec. 27.

NEW YORK.

	Dec. 20.	Dec. 27.	Shares sold.		Dec. 20.	Dec. 27.	Shares sold.
All.-Ch.	15⅛	15*	750	Int.-Met.,pfd..	61	62	35,640
All.-Ch., pfd..	55	54¼	1,400	Mackay Cos..	90½	91½	433
Amal. Cop...	87⅞	87¾	106,700	MackayC.,pfd.	77½*	77½	798
Am. D. T....	20½	20½*	———	Man. Elev....	139½	138¼	1,200
Am. Loc.....	60¾	59¼	1,900	Met. St. Ry..	23*	23*	———
Am. Loc. pfd.	114*	116	200	N.Y.&N.J.Tel.	139¼*	139¼	———
Am. Tel. & C.	77½*	77½*	———	Steel, com....	91⅞	90⅞	365,150
Am. T. & T..	142½	142½	10,850	Steel pfd....	125	125⅜	6,425
B. R. T.....	80½	79½	13,240	W. U. T.....	77½	76⅝*	2,400
Gen. Elec....	160	159½	3,296	West'h., com.	81¾	81½	9,600
Int.-Met.,com.	24¼	24⅞	40,300	West'h., pfd..	133*	133*	———

PHILADELPHIA.

	Dec. 20.	Dec. 27.		Dec. 20.	Dec. 27.
Am. Rys.....	47	47	Phila. Elec.....	13⅞	13⅞
Elec. Co. of A.....	12¾*	12⅜*	Phila. R. T.....	27¾	26⅞
Elec. St. B'ty.....	58¼	60	Phila. Trac.....	88½*	88½*
E. S. B'ty, pfd.....	30*	30*	Union Trac.....	52½	52

CHICAGO.

	Dec. 20.	Dec. 27.		Dec. 20.	Dec. 27.
Chi. City Ry.....	180*	180*	Chi. Tel. Co.....	136*	137*
Chi. Rs., Ser. 1.....	105	109	Met. El., com.....	19¼*	17¾
Chi. Rs., Ser. 2.....	33	32	Met. El., pfd.....	58	55½*
Com. Edison.....	118½	118½	Nat'l Carbon.....	103¾	100
Chi. Subways.....	4⅞*	4¾*	Nat'l Car., pfd.....	123*	122½*

BOSTON.

	Dec. 20.	Dec. 27.		Dec. 20.	Dec. 27.
Am. T. & T.....	142⅝	142½	Mex. Tel.....	2½*	2¾
Cum. Tel.....	145⅜*	145⅜*	Mex. Tel., pfd.....	5½*	5½*
Edison E. Ill.....	250	250½	N. E. Tel.....	137	138
Gen. Elec.....	160	159*	W. T. & T.....	15	17*
Mass. E. Ry.....	15½	16½	W. T. & T., pfd....	96	93
Mass. E. R., pfd....	79	78½			

* Last price quoted
Shares sold are for week of Dec. 20 to Dec. 24.

CONSOLIDATED GAS COMPANY.—It was announced last week that the Consolidated Gas Company of New York had completed negotiations for the purchase of the New York & Queens County Electric Light & Power Company and the Kings County Electric Light & Power Company. The former of these companies is controlled by Frank Tilford, of Park & Tilford, and the latter by Anthony N. Brady, who is deeply interested in the Consolidated Gas Company. The purchase of these companies practically gives the Consolidated Gas Company direct control of the entire lighting and power business of Greater New York. The Queens County Company supplies electric lighting to the entire borough of Queens, while the Kings County Company does a large part of the lighting business for the borough of Brooklyn. The latter company now has an application before the Public Service Commission for permission to issue $5,000,000 of new bonds.

HODENPYL-WALBRIDGE MERGER.—The proposed merger of Michigan power properties, which is being engineered by Hodenpyl, Walbridge & Company and W. E. Clark & Company, will be completed, so it is said, by Jan. 1. The merger will embrace the Grand Rapids Railway Company, Grand Rapids-Muskegon Power Company, the Commonwealth Power Company, the Michigan Light Company and the water rights on the Ausable River. The entire capital involved in the merger will be in the neighborhood of $25,000,000. It is claimed that the water rights on the Ausable River are the most valuable in the State of Michigan. Though they are not yet developed, they offer great possibilities. These rights formerly belonged to the Louds and were taken over by the Hodenpyl interests last summer. In addition to these power and electric plants the merger will take in the gas properties at Kalamazoo, Jackson, Pontiac, Saginaw and Bay City.

AMERICAN TELEPHONE & TELEGRAPH FINANCING.—While there will, of course, be some additional financing during 1910 by the American Telephone & Telegraph Company, it is generally understood that there will be no new issues of telephone company stock or bonds during the early part of the year. It may be that the present shareholders will be offered a limited subscription some time in the fall. It is roughly estimated that the merger of the Bell companies with the Western Union Telegraph Company will save the former something like $50,000,000 of new construction work that would have had to be undertaken in the next five or six years. It is said that construction work for 1910 will be at least $10,000,000 less than it would have been if there had been no merger with the telegraph company.

NATIONAL CARBON COMPANY.—It is said that the earnings of the National Carbon Company for the current year will be the largest in the history of the organization. The fiscal year of the company closes Jan. 31, and based on the 10 months which ended Nov. 30, it seems probable that the net profits of the company will reach $1,100,000. Last October the company placed its common stock on a 5 per cent basis and it is promised that 6 per cent will be paid in 1910. It is said, in fact, that the company is earning about 14 per cent on its common stock. At the same time, the National Carbon Company is selling its product on a narrower margin of profit than ever before. The vast expansion in the electrical lighting industry is responsible for the increased earnings.

GUANAJUATO POWER & ELECTRIC COMPANY.—The Guanajuato (Mex.) Power & Electric Company, which is controlled by Colorado Springs capitalists, has increased its capital stock from $3,500,000 to $5,000,000 for the purpose of absorbing other electric power properties in the same district of Mexico. The properties to be absorbed are located in Leon, Selao, Trapato, Aile de Santiago and Jenjamo, the field embracing a population of about 300,000. At present the company covers a field of 11,250 square miles, and its contemplated expansion will develop manufacturing enterprises and irrigation schemes on a large scale.

SOUTHERN COLORADO POWER COMPANY SOLD.—The Northern Securities Company bought at sheriff's sale Dec. 24 the property of the Southern Colorado Power & Railroad Company. The price paid was $500,000, and the sale occurred at Trinidad. It is stated that the Northern Securities Company is a temporary holding company for the Colorado Railway, Light & Power Company, which was incorporated Dec. 21 with a capital stock of $5,000,000.

EDISON ELECTRIC ILLUMINATING COMPANY OF BROCKTON.—The Gas Commissioners of Massachusetts have approved an issue of $160,000 additional capital stock of the Edison Electric Illuminating Company of Brockton. The stock is to be issued at $148 per share. The proceeds of 771 shares are to be used for the payment of an equal amount of promissory notes which have been outstanding since last May; the proceeds of 302 shares are to meet obligations incurred in the purchase of the Stoughton Gas & Electric Company. The balance of the money is to be used to pay for additions to the company's plant which were made last summer. The Gas Commissioners have also approved the purchase of the Bridgewater Electric Company. The Brockton Company bought this plant for $6,000, subject to a mortgage of $15,000.

NO EXTRA WESTINGHOUSE DIVIDENDS.—At the regular quarterly meeting of the directors of the Westinghouse Electric & Manufacturing Company no action was taken in the direction of paying any portion of the overdue dividends on the cumulative preferred stock. The regular quarterly dividend was declared, but it was deemed wiser to make certain offset charges rather than pay any portion of the back dividends at this time. At the meeting in September last 3½ per cent was declared on the 12½ per cent that was overdue. It was understood that the balance of the 9 per cent would be taken up in 3 per cent payments during the next three-quarters. The earnings of the company are very satisfactory, but it is the policy of the company to proceed conservatively.

OHIO MAY HALT MORGAN TELEPHONE DEAL.—U. G. Denman, Attorney-General of Ohio, declares that the recent purchase of the United States Telephone Company and the Cuyahoga Telephone Company, of Cleveland, by J. P. Morgan & Company, is contrary to the telephone laws of the State, and he promises to take action in the courts to prevent the consummation of the deal. Mr. Denman says that the sale is virtually a combination between the telephone trust and the independent lines.

WETMORE LEAVES UNION ELECTRIC LIGHT & POWER COMPANY.—C. W. Wetmore, former president of the North American Company, resigned last week from the board of directors of the Union Electric Light & Power Company of St. Louis. James Campbell, the new president of the North American Company, was elected to the board in Mr. Wetmore's place. It is said that at the next meeting of the board of directors Alton S. Miller, vice-president and general manager of the company, will be elected president.

CHARLESTON (W. VA.) TELEPHONE COMPANY SOLD.—It is announced that the Charleston (W. Va.) Home Telephone Company has been sold to Cyrus Huling, of Columbus, Ohio, representing a syndicate of capitalists, for $200,000. A promise was exacted from Mr. Huling that control will not be allowed to pass into the hands of the Bell interests. It is generally believed that J. P. Morgan & Company is back of this deal.

ELECTRIC STORAGE BATTERY DIVIDEND.—The Electric Storage Battery Company, of Philadelphia, has declared increased dividends on both its preferred and common issues. The new rate is 1 per cent quarterly on each issue, which is an increase of ¼ per cent over the rate that has prevailed during the earlier part of the year.

SEATTLE LIGHTING COMPANY.—N. W. Harris & Company, of New York, have purchased $1,200,000 of the 5 per cent refunding bonds of the Seattle Lighting Company. These bonds are being offered to the public at 97½ and interest.

DIVIDENDS.

Bell Telephone Company of Canada, quarterly, 2 per cent, payable Jan. 15.

Carolina Power & Light Company, Raleigh, N. C., preferred, quarterly, 1½ per cent, payable Jan. 1.

Central & South American Telegraph Company, quarterly, 1½ per cent, payable Jan. 8.

Electric Boat Company, preferred, quarterly, 2 per cent, payable Dec. 31; common, annual, 2 per cent, payable Jan. 10.

Electric Storage Battery Company, preferred and common, quarterly, 1 per cent each, payable Jan. 3.

International Nickel Company, preferred, quarterly, 1½ per cent, payable Feb. 1; common, quarterly, 1½ per cent, extra ½ per cent, payable March 1.

Metropolitan West Side Elevated Railroad Company, Chicago, preferred, quarterly, ¾ per cent, payable March 1.

Mexican Telegraph Company, quarterly, 2½ per cent, payable Jan. 15.

Milwaukee Electric Railway & Light Company, preferred, quarterly, 1½ per cent, payable Jan. 15.

Narragansett Electric Lighting Company, quarterly, $1 per share, payable Jan. 1.

Oklahoma Gas & Electric Company, preferred, quarterly, 1¾ per cent, payable Jan. 15.

Ottumwa (Ia.) Railway & Light Company, quarterly, 1¾ per cent, payable Jan. 15.

Pacific Telephone & Telegraph Company, preferred, 1½ per cent, payable Jan. 15.

Providence Telephone Company, quarterly, $1 per share, payable Jan. 1.

San Diego (Cal.) Consolidated Gas & Electric Company, preferred, quarterly, 1¾ per cent, payable Jan. 15.

Southern New England Telephone Company, quarterly, $1.50 per share, payable Jan. 15.

Union Switch & Signal Company, preferred and common, quarterly, 3 per cent, payable Jan. 10.

REPORTS OF EARNINGS.

	Gross earnings.	Expenses.	Net earnings.	Charges.	Surplus.
American Light & Traction Company:					
November, 1909	$333,649	$8,644	$325,004	.....	.....
November, 1908	282,695	2,000	280,695	.....	.....
American Telephone & Telegraph Company:					
November, 1909	2,149,801	246,907	1,902,894	$524,182	$1,378,712
November, 1908	2,060,844	169,388	1,891,450	638,867	1,252,589
Aurora, Elgin & Chicago Railroad Company:					
November, 1909	122,788	69,535	53,263	29,585	23,678
November, 1908	109,912	64,979	44,943	27,723	17,220
Central & South American Telegraph Company:					
Quarter ended Dec. 31, 1909 (estimated)	445,500	167,000	278,500	143,565	140,135
Quarter ended Dec. 31, 1908	415,000	165,000	250,000	143,565	110,935
Detroit United Railroad Company:					
November, 1909	676,482	440,750	235,732	157,919	88,424
November, 1908	570,711	374,685	196,026	132,819	69,704
Edison Electric Illuminating Company of Brockton, Mass.:					
October, 1909	25,972	12,164	13,808	3,165	10,642
October, 1908	19,218	10,020	9,197	2,861	6,336
Lake Shore Electric Railway Company, Cleveland:					
November, 1909	90,705	48,984	41,721	35,392	6,328
November, 1908	80,476	47,439	33,036	34,242	*1,205
Lowell (Mass.) Electric Light Corporation:					
October, 1909	33,843	17,377	16,466	3,566	12,900
October, 1908	30,673	17,824	12,848	2,849	9,999
Mexican Telegraph Company:					
Quarter ended Dec. 31, 1909 (estimated)	195,000	37,500	157,500	.....	84,765
Quarter ended Dec. 31, 1908	172,000	41,000	131,000	.....	77,752
Montreal Street Railway Company:					
November, 1909	334,871	200,138	134,733	30,785	103,949
November, 1908	301,578	180,682	120,896	29,662	91,234
Northern Ohio Traction & Light Company:					
November, 1909	175,742	99,972	75,770	43,399	32,370
November, 1908	151,934	87,976	63,958	44,011	19,946
Northern Texas Electric Company:					
October, 1909	135,696	64,594	71,102	16,189	54,912
October, 1908	119,298	56,103	63,195	15,187	48,008
Portland (Me.) Electric Company:					
November, 1909	36,898	11,864	25,034	9,194	15,840
November, 1908	32,335	10,714	21,630	8,983	9,647
Savannah Electric Company:					
October, 1909	50,618	32,972	17,645	15,954	1,691
October, 1908	51,070	30,303	20,766	15,911	4,855

*Deficit.

GENERAL NEWS

Construction News.

BRIDGEPORT, ALA.—A company has been organized to establish an electric light plant in Birmingham. A. W. Scarborough and associates are interested in the enterprise.

NOME, ALASKA.—The plant and holdings of the Nome Light Company have been sold to the Seward Peninsula Power Company, 421 Mutual Life Building, Seattle, Wash.

FLORENCE, ARIZ.—Arrangements are being made to light the streets of the city, electricity for which will be supplied from the electric plant at the Territorial penitentiary.

PHOENIX, ARIZ.—Plans are being formulated for the completion of several more units of the hydroelectric system planned by the Reclamation Service for the benefit of this valley.

RAY, ARIZ.—Preparations are being made by the Ray Consolidated Copper Company to install a subsidiary electric power plant at its main working shaft in order to prosecute development on ore bodies until the main electrical shaft at Winkelman is completed.

TUCSON, ARIZ.—It is reported that the Helvetia Copper Company contemplates the installation of a large electric power plant on its holdings in the near future.

COMPTON, CAL.—Application has been made to the Board of Trustees by W. L. Frew and W. G. Logg, of the Consolidated Utiltities Company, for a franchise in this city for the transmission of electricity for lamps, heat and motors. Bids for the franchise will be received by H. T. Dunning, city clerk, until Jan. 4.

LOS ANGELES, CAL.—The Los Angeles Railway Company is planning to construct about 80 miles of new track during 1910. H. E. Huntington is general manager.

OAKLAND, CAL.—Application has been made to the City Council for a franchise on several streets in the city by the Peninsular Railroad Company.

REDWOOD, CAL.—A petition has been presented to the Board of Supervisors by Benjamin Cunha, asking that steps be taken to sell a franchise for installing and maintaining electric lamps in Miramar, Halfmoon Bay and Pursima school districts.

SANTA BARBARA, CAL.—Plans for the construction and operation of a co-operative electric light plant are being perfected by the business men on State Street between Haley and De la Guerra streets, to supply electricity for their own use.

SANTA BARBARA, CAL.—J. H. Hiller, chairman of the city water works commission, states that a hydroelectric power plant and an overhead distributing system for supplying electricity in Santa Barbara could be installed in Mission Canyon by the city at a cost of about $100,000. It is said that plans will be prepared for the plant provided the citizens want it.

VISALIA, CAL.—J. B. Fleming has completed the plant of the Globe Light & Power Company at Daunt, Cal., and is now constructing a hydroelectric plant in the Sequoia National Park for the Mount Whitney Company.

COLORADO SPRINGS, COL.—The Grand Junction & Grand River Valley Railway Company has surveyed the route for its proposed electric railway between Grand Junction and Fruita, a distance of 20 miles. The pole bracket type of overhead construction will be installed. Contracts will soon be awarded for material for the construction of a power plant. Orders will also be placed in the near future for three interurban cars and possibly an electric locomotive.

CANAAN, CONN.—Plans are being considered by the Berkshire Power Company for the construction of a large addition to its power plant on the Housatonic River next spring. The company proposes to install an auxiliary steam plant to supplement its water power.

NEW HAVEN, CONN.—The committee on lighting has voted to award the contract for electric lighting to the United Illuminating Company. There are about 630 electric lamps in use in the city.

NEW LONDON, CONN.—It is reported that the New London & East Lyme Street Railway Company will construct about 10 miles of new track during 1910. L. S. Rudd is superintendent.

WASHINGTON, D. C.—Bids will be received until Jan. 21 by the Department of the Interior, Washington, D. C., for remodeling the power plant at the Government Hospital for the Insane, Washington, D. C., in accordance with plans and specifications, copies of which, with proposal forms, can be secured on application at the Department. J. E. Wilson is assistant secretary.

TIGER BAY, FLA.—The Palmetto Phosphate Company has recently placed in operation its new producer gas electrical generating plant, the equipment of which includes one 1100 hp producer gas plant in three units, three 18 x 24-in. single-tandem gas engines direct connected to 200-kw, 2300-volt generators together with the necessary exciters, transformers, switchboards, etc. A large number of motors have also been installed. The equipment was furnished by the Allis-Chalmers Company, of Milwaukee, Wis.

EDISON, GA.—The question of issuing $8,000 in bonds for construction of an electric light plant will be submitted to a vote of the people.

LA FAYETTE, GA.—The City Council would like to receive propositions for the installation of an electric light plant and water works system. For further information address C. J. Hammond, city recorder.

MARIETTA, GA.—The Board of Water Commissioners has placed orders with the Allis-Chalmers Company for a 16 x 36 non-condensing engine, direct connected to a 175-kw, 60-cycle, three-phase, 2300-volt, 120 r.p.m. generator and a 15-kw, 120-volt belted exciter set; also switchboard with equipment.

IDAHO FALLS, IDAHO.—The Idaho Power & Transportation Company, which recently purchased the property of the St. Anthony Light & Power Company, which furnishes electrical service in Rexburg, Teton City, Sugar City, Salem and St. Anthony, is installing two additional units, with a rating of 600 hp each, in its power plant near Idaho Falls. The company now has about 75 miles of transmission lines.

OSBURN, IDAHO.—It is reported that the United Lead Mining Company contemplates the installation of electrical power to operate the machinery recently installed at its mines.

CANTON, ILL.—The Illinois Central Electric Railway Company contemplates extending its system from Norris to Fairview, Ill., which will require the construction of about eight miles of new track. L. W. Morton is purchasing agent.

CHICAGO, ILL.—The capital stock of the Standard Gillett Light Company has been increased from $50,000 to $100,000.

CHICAGO, ILL.—Bids will be received by the City of Chicago, Ill., until Jan. 29, for furnishing and installing the lighting fixtures for the new city hall building, according to plans and specifications on file at the office of the Department of Public Works, room 705, City Hall. A deposit of $25 will be required to insure the safe return of the plans. John J. Hanberg is Commissioner of Public Works.

EAST MOLINE, ILL.—The Root & Vandervoort Company is reported to be making preparation to operate its plant by electricity. The United Light & Power Company will furnish electrical service.

MURPHYSBORO, ILL.—The Murphysboro Electric Railway, Light, Heat & Power Company contemplates the construction of seven miles of new track between Murphysboro and Carbondale during 1910.

TREMONT, ILL.—The capital stock of the Farmers' Mutual Telephone Company of Tazewell County has been increased from $20,000 to $40,000.

BLOOMFIELD, IND.—The capital stock of the Home Light & Water Company has been increased from $20,000 to $30,000. E. H. Dugger is president.

EVANSVILLE, IND.—The Evansville Public Service Company, which was recently granted a 25-year franchise in Evansville, has selected a site at Sixth and Canal streets, on which it will build its proposed power plant, providing the City Council will permit the Evansville Suburban & Newburgh Railway Company to run steam-hauled coal cars into the plant.

FAIRMONT, IND.—The Citizens' Co-operative Telephone Company has purchased the plant and holdings of the Fairmont Telephone Company, which is part of the independent telephone system of the State. The Citizens' company is allied with the Bell telephone system.

FORT WAYNE, IND.—The Board of Public Works has awarded the contract for the installation of a 425-hp Lyons safety boiler in the municipal electric light plant to the P-K Engineering Company, of St. Louis, Mo., for $6,250.

GARY, IND.—The Gary & Southern Traction Company contemplates connecting Crown Point with Gary in the spring of 1910, which will require the building of about 12 miles of new track.

INDIANAPOLIS, IND.—The Merchants' Heat & Light Company has commenced work on the erection of lamp posts on Washington Street in connection with the plan for the illumination of the entire downtown district. Each post will carry five lamps, the merchants bearing the cost of electricity for the same.

LINTON, IND.—Plans are being considered to change the course of the Eel River so as to run through Linton and Jasonville and to develop the water power of the river near Linton to furnish electricity for both cities and surrounding towns.

UPLAND, IND.—It is reported that the Council will soon award contracts for construction of a combined electric light and water works plant.

DYERSVILLE, IA.—Preparations are being made by the Interstate Telephone Company for extensive improvements to its system, work on which will begin early in the spring. Its toll lines and many rural lines will be rebuilt. J. M. Dunn, of Earlville, is president.

EARLHAM, IA.—Work has commenced on the construction of the municipal electric light plant and water works system in Earlham.

FARRAR, IA.—An independent telephone company has been organized by farmers residing in and near the Town of Farrar. The company is capitalized at $5,000 and the officers are: J. T. Dunlap, president; Asa Turner, vice-president and H. E. Fleagle, secretary and treasurer.

MARENGO, IA.—At an election held Dec. 14 the citizens voted in favor of renewing the franchise of the Marengo Electric Light & Power Company for 10 years.

MARION, IA.—At an election held Dec. 20 the proposition to extend the franchise of the Marion Light, Heat & Power Company for its lighting and heating systems was carried by a large majority.

MARSHALLTOWN, IA.—Plans are being considered by the Iowa Central Railroad Company for further extensions to its repair shops. It is said that motor-driven tools and probably a crane will be required later.

SPIRIT LAKE, IA.—The City Council is reported to have sold the municipal electric light plant. Under the terms of the sale the parties purchasing the plant are to pay $1,000 in cash and to furnish electricity for street lighting for a term of five years. Municipal ownership of the lighting plant in this city has been a failure. The plant was given to the city free of debt and in good condition nine years ago. Since that time the city has expended $21,434 on the plant, which has furnished street lighting for the town and power for the municipal water plant. It is estimated that the service could have been obtained from a private plant for $12,600.

CANEY, KAN.—The City Council is contemplating the purchase of the local electric light plant owned by the Caney Electric Light & Power Company.

CANTON, KAN.—The question of establishing an electric light plant and water works system in Canton is reported to be under consideration.

MARION, KAN.—The contract for the construction of an electric light plant and water works system in Marion was awarded to the Squire Electric Company, of Kansas City, Mo., for $60,000. Burns & McDonnell, of Kansas City, Mo., are engineers.

SYRACUSE, KAN.—The city is reported to have voted to issue $39,000 in bonds, the proceeds to be used for the construction of an electric light plant and water works system.

ADAIRVILLE, KY.—S. C. Robb and Dr. Gilbert, both of Nashville, Ky., promoters of the proposed Nashville & Adairville Interurban Railway Company, have assured the citizens of Adairville that if the people along the railway would subscribe for stock to the amount of $100,000 that the road would be immediately located and contracts for construction awarded.

HIGHBRIDGE, KY.—Arrangements are being made by the Madison Electric Power Company for the construction of a hydroelectric power plant on the Dix River, near Highbridge. The company proposes to build a dam 150 ft. high and 522 ft. long which will develop about 8000 hp for transmission by electricity. The cost of the plant is estimated at about $800,000. Robert E. Hughes, of Richmond, Ky., is president.

MILLERSBURG, KY.—The Council has awarded a contract to Siebert-Herndon Electric Company to install an electric light plant to furnish electricity for lighting the streets, public buildings and places to cost $8,200. The company was granted a franchise to construct a power plant to furnish electricity for commercial lighting and residences at a cost of $12,500.

DOVER, MAINE.—Extensive improvements are being made to the power station of the Dover & Foxcroft Light Company at East Dover, which includes the installation of a new 150-hp boiler and a 250-hp engine, increasing the output of the plant to 500 hp. The station will be used as an auxiliary to the water power plant. The company furnishes electricity for lamps in Dover, Foxcroft and Sangerville.

FREEPORT, MAINE.—The A. W. Shaw Company is reported to have entered into a contract with the electric light company at Yarmouth to furnish electricity to operate part of its factory. It is understood that the necessary changes will be made in about 60 days.

BALTIMORE, MD.—Plans are being prepared by the Baltimore & Ohio Railroad Company for the construction of an addition to its electric plant at 1029-1031 Park Avenue, Baltimore, Md., to cost about $10,000. A. M. Kinsman, of Baltimore, Md., is chief engineer.

ELKTON, MD.—It is understood that a bill will be presented to the next Legislature asking that the Town Council of Elkton be given authority to issue bonds sufficient to construct an electric light plant and water works system.

BROCKTON, MASS.—The Board of Gas and Electric Light Commissioners has issued an order approving an issue of 1488 shares of capital stock of the Edison Electric Illuminating Company of Brockton at $140 per share, the proceeds to be used as follows: Of 771 shares to the cancellation of promissory notes; 302 shares to the payment of obligations incurred in the purchase of the property of the Stoughton Gas & Electric Company, and 415 shares to the payment of costs of permanent additions to the plant. The board has also given its approval to the terms under which the Edison Company is to absorb the Bridgewater Electric Company.

GREENFIELD, MASS.—The Connecticut Valley Street Railway Company has filed a petition with the Secretary of the Commonwealth for presentation to the State Legislature asking for permission to build a street railway in the Mt. Sugar Loaf Reservation in South Deerfield.

LEE, MASS.—The auxiliary plant of the Lee Electric Light Company, located in East Lee, was destroyed by fire on Dec. 20, causing a loss of about $6,000.

NEW BEDFORD, MASS.—The citizens of East Fairhaven are contemplating asking the New Bedford Gas & Edison Light Company to extend its service from Mattapoisett to East Fairhaven.

ROWLEY, MASS.—At a special town meeting held recently the citizens voted to install an electric light system. The service is to be furnished from the municipal electric light plant at Ipswich.

SALEM, MASS.—The Common Council has passed an order to petition the Legislature for authority to require the placing of all electric wires underground in the thickly settled parts of the city.

WESTBORO, MASS.—The State Gas and Electric Light Commissioners have authorized the Westboro Gas & Electric Company to issue 115 shares of its capital stock at par value of $100 per share, the proceeds to be used to pay for the cost of additions to its plant.

BIRMINGHAM, MICH.—The Village Council is reported to be considering the installation of an electric light system.

BUCHANAN, MICH.—The Village Board is considering the question of replacing the present street lamps on Main Street with tungsten lamps.

DETROIT, MICH.—Orders have been placed by the Detroit Copper & Brass Rolling Mills Company with the Allis-Chalmers Company for additional machinery for its power plant as follows: One 750-kw, 480-volt, 60-cycle, three-phase alternator direct connected to a low pressure turbine and a 200-kw, 240-volt, synchronous motor-generator set.

LAINSBURGH, MICH.—Preparations are being made by J. Naldrett, of Lainsburgh, Mich., for the construction of an electric light plant, work on which will begin in April, 1910. The cost of the work is estimated at from $7,000 to $8,000.

LOWELL, MICH.—It is reported that a special election will be held to vote on the proposition to issue $7,000 in bonds, the proceeds to be used to complete the municipal electric light plant.

PONTIAC, MICH.—The City Council has refused the Detroit Edison Company permission to erect a large transformer station in Pontiac on the ground that the company asked too many privileges.

SAGINAW, MICH.—Plans are being considered by the Erd Motor Manufacturing Company, of Saginaw, Mich., for construction of a new plant for manufacturing gasoline engines. A number of machines, tools, presses, pneumatic appliances, and other apparatus will be required, together with power equipment.

GRANITE FALLS, MINN.—The City of Granite Falls has awarded a contract to the Power Engineering Company, Minneapolis, Minn., to design, construct and furnish material for a complete hydroelectric power plant, consisting of a new reinforced concrete flume, one unit of four horizontal wheels, complete rope transmission, etc., work to commence on the plant April 1, 1910. E. H. Sorlein is Mayor.

MARBLE, MINN.—It is reported that the Oliver Mining Company will install a lighting plant in Marble.

MINNEAPOLIS, MINN.—Arrangements are being made by the Northwestern Telephone Exchange Company for extensions to its system and the installation of cables, which will involve an expenditure of about $1,200,000. It is said that the same amount will be expended in St. Paul, Minn.

ST. PAUL, MINN.—The only bid received by the City Council for lighting the streets by electricity for the coming year was submitted by the St. Paul Gas Light Company. Under the bid submitted the price of arc lamps is reduced from $85 to $80 per lamp per year for lamps served on overhead system and the city is allowed to increase the number to 900 on the overhead circuits at the same rate. For all over 900 the rate will be $7 per month per lamp. A reduction of $1 per lamp per year was made on the gas lamps. Under the contracts for 1910, the city will save about $12,500 as compared with this year.

STILLWATER, MINN.—The capital stock of the Washington County Light & Power Company has been increased from $100,000 to $1,000,000. The company, it is said, proposes to extend its transmission lines to furnish electrical service in other cities and towns.

WADENA, MINN.—Work will soon commence by the Leaf River Rural Telephone Company for the construction of its main telephone line and branches.

JACKSON, MISS.—The Home Telephone Company, which is erecting long distance telephone lines from Meridian and Hattiesburg into Jackson, is planning to build a long distance line from Hattiesburg into Natchez, traversing the right of way of the Mississippi Central railway. A line will also be erected from Jackson to Bogalusa along the line of the New Orleans Great Northern Railroad. The company has applied for a franchise in Natchez and proposes to install a local system in that place if the franchise is granted.

ASH GROVE, MO.—An election will soon be held to vote on the proposition of granting a franchise to J. A. Long, president of the Ash Grove Milling Company, and J. L. Hine, of the Merchants' National Bank, of Springfield, Mo., a franchise to operate an electric light plant in Ash Grove. It is proposed to install an electric plant to be operated by power from the Ash Grove mill. The cost of the equipment is estimated at from $8,000 to $9,000.

CARROLLTON, MO.—Arrangements are being made by the Bell Telephone Company to rebuild its system in Carrollton, which will involve an expenditure of about $13,000.

EAST ST. LOUIS, MO.—It is reported that the American Steel Foundries Company will install two engine-driven generators with a rating of 500 hp each in its power plant at East St. Louis.

KANSAS CITY, MO.—The Kansas City Steel Scraper Company is contemplating the erection of a large foundry and manufacturing plant, equipped with traveling cranes, hoists, conveyors and special machinery. Power for operating the plant will be furnished from a central station, the equipment of which will include boilers, engine, generator, etc. The works will be equipped for electric motor drive throughout.

KIRKWOOD, MO.—The Municipal Electric Light Commission has awarded a contract to the Raming Machine Company, of St. Louis, Mo., for the installation of a 180-kw generator and 230-hp engine. The new equipment will more than double the present output of the plant.

LEES SUMMIT, MO.—L. G. Morris, who recently purchased the local electric light plant owned by L. Screechfield & Son, has applied to the City Council for an electric light franchise. The granting of the franchise will be subject to a vote of the people.

MONETT, MO.—It is reported that bonds have been voted to establish a municipal electric lighting system in Monett.

ST. JAMES, MO.—The St. James Ice & Power Company is contemplating the installation of a steam turbo-generator set to take care of the day load. L. E. Zweig is manager and A. B. Bridgeman is chief engineer of the company.

ST. LOUIS, MO.—It is reported that the J. C. Kupferle Foundry Company contemplates the construction of a new plant, which will be equipped with electric motor-driven machinery throughout.

LINCOLN, NEB.—The State Railway Commission has granted the Burt County Telephone Company permission to increase its capital to the amount of $75,000. The company has recently purchased the plants at Lyons, Oakland and Decatur and expects to extend and enlarge them.

HOBOKEN, N. J.—The Public Service Corporation of New Jersey has purchased the plant and holdings of the Weehawken Contracting Company, which has for some time been furnishing electricity for lamps in the northern part of Hudson County.

NEWARK, N. J.—The Breeze Carburetor Company, of Newark, N. J., is reported to be in the market for equipment for a power plant, including engine, generator, boiler, heater, pumps, etc.

CLOVIS, N. M.—The City Council has granted E. J. Howard, J. D. Hammett and A. R. Hammett, of Moberly, a franchise to construct and operate a street railway system in Clovis.

BROOKLYN, N. Y.—Bids will be received by the Board of Health, Department of Health, Fifty-fifth Street and Sixth Avenue, New York, N. Y., until Jan. 4 for furnishing and installing electric and gas lighting fixtures, etc., in the office building at Fleet and Willoughby Streets, Brooklyn, N. Y. Blank forms and plans may be obtained at the office of the chief clerk of the Department of Health at the above office. Thomas Darlington, M.D., is president, Department of Health.

CAMDEN, N. Y.—The question of abandoning the municipal electric light plant is under consideration. It has not yet been decided whether to maintain the present system or to sell the franchise and lease the system to a private company. It is proposed to hold a special election to vote on the matter.

DUNKIRK, N. Y.—The Dunkirk Power & Heating Company is constructing a large addition to its power plant to provide space for the installation of three-phase, alternating-current apparatus in units aggregating several thousand hp. The company is seriously considering the installation of gas engines to drive its plant. H. T. Litchfield is vice-president and secretary.

FULTON, N. Y.—No bids were received by the City Council for the franchise offered for sale Dec. 20 to furnish electricity for lamps and motors in Fulton. It is said that the Niagara-Oswego Company did not make a bid on the franchise, hoping to obtain a more favorable franchise from the administration which will take charge of affairs Jan. 1.

HILTON, N. Y.—The Hilton Electric Light, Heat & Power Company contemplates the construction of an electric light plant in Hilton.

HORNELL, N. Y.—The Public Service Commission, Second District, has granted the Hornell & Bath Interurban Railway Company a certificate for the construction of a street railway to extend from Hornell to Bath, a distance of 24 miles. The company is capitalized at $250,000.

LONG ISLAND CITY, N. Y.—The Stevenson Construction Company is reported to be in the market for complete equipment for a power plant of from 200 to 300 hp for a new factory.

MINEVILLE, N. Y.—The Public Service Commission, Second District, has granted the Mineville Light, Heat & Power Company permission to exercise its franchises granted by the Town of Moriah to operate in the villages of Mineville and Witherbee; also to issue capital stock to the amount of $10,000, of which the proceeds of $3,634 is to be used for the purchase of an electric light plant built by Witherbee, Sherman & Company and the remainder to be used for extensions and improvements to the plant.

NEWARK, N. Y.—The plant and holdings of the New Electric Light, Heat & Power Company, of Newark, N. Y., has been purchased by W. T. Morris and associates. The Morris syndicate already owns the controlling interest in the Newark Gas Light & Fuel Company. The new officers were elected as follows: W. T. Morris, president and treasurer and Morris Tracy, secretary.

NEW YORK, N. Y.—The Walter D. Carpenter Company, 39 Cortlandt Street, New York, N. Y., is reported to be in the market for a 200-hp electric generating unit, together with auxiliary apparatus.

NEW YORK, N. Y.—Bids will be received at the General Depot of the Quartermaster's Department, Army Building, New York, N. Y., until Dec. 31, for electric wiring system for the United States Army Building, New York, N. Y., in accordance with circular schedule No. 26. William S. Patton, assistant quartermaster-general, U. S. A., is depot quartermaster.

NEW YORK, N. Y.—Bids will be received by John W. Brannan, president of the Board of Trustees, Bellevue and Allied Hospitals, 411 East Twenty-sixth Street, New York, N. Y., until Jan. 7 for furnishing and installing electric and gas lighting fixtures in the pathological department and male dormitory of the new Bellevue Hospital, situated on First Avenue between Twenty-sixth and Twenty-ninth Streets. Blank forms may be obtained at the office of the contract clerk, 419 East Twenty-sixth Street.

NEW YORK, N. Y.—Announcement has been made that negotiations have been completed by the Consolidated Gas Company for the purchase of the properties of the New York & Queens County Electric Light & Power Company and the Kings County Electric Light & Power Company, which gives the Consolidated company control of the entire lighting business of Greater New York. The Queens County company supplies electricity for lighting the entire Borough of Queens, and the Kings County company a large part of Borough of Brooklyn. The last-named company now has an application before the Public Service Commission for permission to issue $5,000,000 in bonds.

SYLVAN BEACH, N. Y.—The Board of Trustees has decided to install an electric lighting plant at Sylvan Beach, having sufficient output to furnish electricity for 1,000 lamps of 16 cp. No contracts have been placed for equipment as yet. The plant will be driven by a gasoline engine. E. J. Brown is clerk.

UTICA, N. Y.—The Allis-Chalmers Company, of Milwaukee, Wis., will furnish the power equipment for the new factory now being built by the Utica Fine Yarn Company, which will include one 937-kva, 600-volt, 60-cycle, three-phase alternator direct connected to a steam turbine, a 22½-kw, 850 r.p.m., 120-volt motor-driven exciter set and a 17½-kw, 120-volt exciter driven by a 5x5-in. duplex double-acting automatic engine.

WILSON, N. Y.—The Newfane Electric Company, of Newfane, N. Y., has offered to furnish electricity for street lamps in Wilson providing a site for a plant is given the company free of charge. It is said that a deed of the site will soon be given the company.

DILLSBORO, N. C.—Charles J. Harris is reported to be contemplating the construction of an electric light plant on Huckaselgee River.

GOLDSTON, N. C.—O. D. Barber is contemplating the construction of a power plant on Bear Creek to furnish electricity for flour mill, etc. The dam will be about 100 ft. long and 14 ft. wide and will develop about 200 hp. For further information address E. W. Myers, Greensboro, N. C.

NORTHWOOD, N. D.—Plans are being considered by the Red River Valley Telephone Company for the construction of new telephone lines during the coming year.

COLUMBUS, OHIO.—The Casparis Stone Company, of Columbus, Ohio, has recently placed orders with the Allis-Chalmers Company for two large stone-crushing plants, one to be located at Havre de Grace, Md., and the other at Patterson's Creek, W. Va. The power equipment of the Havre de Grace plant includes one 750-kva, three-phase, 60-cycle, 600-volt steam turbo-alternator; one 22½-kw motor-driven exciter set and one 22½-kw engine-driven exciter and switchboard; four 316-hp Heine water tube boilers; one feed water heater and duplicate boiler feed pumps; one 200-hp, one 125-hp and seven 50-hp induction motors for driving various machines. The power apparatus at the Patterson's Creek plant is a duplicate of the Havre de Grace plant.

DAYTON, OHIO.—The People's Railway Company is reported to be contemplating the construction of a new power house at a cost of about $125,000.

YOUNGSTOWN, OHIO.—Plans are being considered by the United Engineering & Foundry Company for the construction of a new machine shop at its works at Youngstown, Ohio, to be equipped with motor-driven tools and pneumatic appliances. An increase in power capacity, it is said, will be required in the near future.

STILLWATER, OKLA.—Bids will be received by the State Board of Agriculture, State Agricultural and Mechanical College, Stillwater, Okla., until Jan. 15 for the construction of power house and heating plant to cost about $15,000. J. H. Connell, of Stillwater, Okla., is president.

WALTER, OKLA.—At a recent election the citizens voted to issue $7,000 in bonds for the construction of an electric light plant.

CANYON CITY, ORE.—Owing to an accident in the boiler room in the local electric plant, the city is without electric light. The streets will be in darkness until the plant is repaired. The company has recently been reorganized. J. E. Marks, president, states that is is proposed to put the plant in first-class condition.

EUGENE, ORE.—The City Council has entered into a contract with the Northwestern Corporation whereby the latter is to furnish electricity for lighting the streets of the city for another year as follows: For arc lamps at the rate of $6 per lamp per month; for incandescent lamps of 32 cp at $2 each per month and 16-cp lamps at $1 each per month and $2 each per month for alley lamps. The city is constructing a municipal electric plant on the McKenzie River, which is expected to be completed within a year.

GRANTS PASS, ORE.—The City Council has granted J. R. Allen a franchise for an electric railway in Grants Pass, Ore. Under the terms of the franchise work must begin on the railway within a year.

MILTON, ORE.—The municipal electric light plant which has been closed for 50 days has been put into service again. Improvements and extensions have been made which will more than double the output of the plant. The output of the power station has been increased from 100 hp to 300 hp and new water wheels and other machinery have been installed, representing an expenditure of about $50,000.

BEAVER, PA.—Plans are being made for the construction of a new plant by the W. E. Leard Machine Company, of Beaver, Pa., and considerable new equipment will be required. The plant will be equipped throughout for electric motor drive.

COLUMBIA, PA.—The Pennsylvania Railroad Company, it is reported, contemplates the installation of a complete electric plant in its round house in Columbia to furnish electricity to operate the machinery and to light the yards and buildings.

CONNELLSVILLE, PA.—The Connellsville Iron Works, which recently decided to enlarge its plant, is contemplating operating its plant by electricity.

JOHNSTOWN, PA.—The plant of the Union Radiator Company, at Johnstown, Pa., will be enlarged and additional power equipment installed.

JOHNSTOWN, PA.—Arrangements are being made by the Cambria Steel Company for the erection of a substation at Johnstown, in connection with its new power system in this place. New equipment will be required, including a rotary converter, transformers, switchboard, etc.

MERCER, PA.—The contract for the equipment for the new power house at the court house has been awarded to the American Heating & Ventilating Company, at a cost of $19,918.

MILTON, PA.—The Milton Manufacturing Company has placed an order with the Allis-Chalmers Company, of Milwaukee, Wis., for a two-stage, single-suction, horizontal shaft, centrifugal pump with a capacity of 2,000 gal. per minute against a head of 237 ft., driven by a 200-hp, 220-volt, direct-current motor.

ORBISONIA, PA.—The Orbisonia Telephone Company has filed a notice of an increase of its capital stock from $10,000 to $50,000 with the Secretary of State.

PITTSBURGH, PA.—The Borough Council of Walls Borough has decided to light the borough by electricity and has awarded a contract to the United Electric Light Company, of Wilmerding, Pa., for furnishing arc lamps at the rate of $60 each per year.

SHARTLESVILLE, PA.—The Shartlesville Rural Telephone Company has awarded the contract for the construction of its telephone lines to William Kauffman, of Reading. The company proposes to build its own line from Hamburg to Shartlesville.

ABERDEEN, S. D.—Application has been made to the City Council for a franchise by Gilborne Brothers to install a lighting and heating plant in Aberdeen, S. D.

HETLAND, S. D.—A movement has been started to establish an electric lighting system in Hetland. It is proposed to ask the Lake Preston Electric Light Company, of Lake Preston, to extend its transmission lines to this town and furnish the service.

BRISTOL, TENN.—The East Tennessee Telephone Company has leased a building on State Street in which equipment will be installed costing about $15,000. The company has commenced work on the erection of two new copper circuits between Bristol and Knoxville.

ERWIN, TENN.—It is reported that P. O. Heat & Company, of Charlotte, N. C., have purchased the "Devil's Looking Glass" water power. The company, it is said, will construct a 35-ft. dam to develop 3000 hp for transmission by electricity.

HUNTINGDON, TENN.—At an election to be held Jan. 22 the proposition to issue $10,000 in bonds, the proceeds to be used to extend the electric lighting system to the East End and other improvements, will be submitted to a vote.

DEL RIO, TEX.—The Del Rio Western Telephone Company has filed an amendment to its charter increasing its capital stock from $60,000 to $80,000.

JOURDANTON, TEX.—Wallace Brothers have secured the contract to construct a water, light and ice plant to cost $40,000 in Jourdanton.

SAN ANTONIO, TEX.—The San Antonio & Southwestern Telephone Company has purchased the plant of the Bandera Telephone Company and several private telephone lines running to Kerrville, Fredericksburg and other points. The company proposes to extend the line to San Angelo and give that section of the country direct connection with San Antonio.

LOGAN, UTAH.—Work will be started at once on the construction of a power plant near Logan to furnish electricity for lamps and motors for the buildings of the Utah Agricultural College. The college owns sufficient water rights in the Logan River to develop 300 hp. The last Legislature made an appropriation of $20,000 to install a power plant for the college buildings.

MURRAY, UTAH.—James W. Cahoon, president of the Progress Company, has applied to the City Council for an extension of the franchise of the Progress Electric Company in Murray.

KIMBALL, VA.—The contract for the proposed electric light plant and water works system has been awarded to L. Kaufman, of Northport, Va. The cost of the work is estimated at $100,000.

PETERSBURG, VA.—Bids will be received by the water committee until Jan. 10 for the complete installation of a pumping plant of 1800 gal. per minute capacity. Propositions will be received and considered on steam, producer-gas and electrically driven pumps. R. D. Budd is city engineer.

RICHMOND, VA.—The Richmond & Chesapeake Bay Railway Company, it is reported, is contemplating two extensions to its system, one of which will extend from Ashland via Fredericksburg and Manassas, Va., to Alexandria, Va., and thence to Washington, D. C., 115 miles in length; the other from Ashland to a point in Stafford County on the Potomac River, a distance of about 80 miles. Cecil L. Reid, of Fredericksburg, Va., will have charge of making the surveys.

SPOKANE, WASH.—The Board of Public Works has recently awarded a contract to the Allis-Chalmers Company, of Milwaukee, Wis., for equipment for the new municipal water works pumping station, which includes six single suction, horizontal shaft, two-stage centrifugal pumps driven by three 900-hp, 2200-volt, 60-cycle, three-phase induction motors. A three-panel switchboard will carry the controlling apparatus.

HUNTINGTON, W. VA.—The Citizens Light & Ice Company contemplates the installation of a 500-hp gas engine in the near future. H. H. Hughes is manager.

MOOREFIELD, W. VA.—A 25-year franchise has been granted to J. H. Marshall and H. O. Barncord, both of Midland, Md., for the construction and operation of an electric light plant in Moorefield, W. Va.

WHEELING, W. VA.—Contracts will be placed by the City & Elm Grove Railroad Company for the construction of 1½ miles of new track in the near future. J. W. Smith is general manager.

EVANSVILLE, WIS.—Arrangements are being made by the Baker Manufacturing Company for new equipment for its power plant, which will include generator with a rating of 112 kw belted to Corliss engine, with exciter and other apparatus.

KAUKAUNA, WIS.—Plans have been prepared by the Fibre Development Company, of Appleton, Wis., for the construction of a 40-ton sulphite mill to be erected by Frank Becker, of Kaukauna, Wis. It is understood that a large battery of boilers, one or more Corliss engines or turbines, generators, motors, etc., will be required.

LA CROSSE, WIS.—The large Dells dam, located two miles above Hatfield, built by the La Crosse Water Power Company, is completed. The Hatfield and Dells dams have cost more than $2,000,000 and furnish power to operate the power plant at Hatfield, which furnishes electricity in the cities of La Crosse and Winona, and will also furnish energy to operate the proposed interurban railway to extend from Winona, La Crosse and Sparta. Announcement is made by the La Crosse Water Power Company that two more dams will be built next year, which will double its water storage capacity.

MERRILL, WIS.—The W. C. Collar Company is contemplating the installation of a new engine and possibly an electric power plant.

MILWAUKEE, WIS.—The Kiel Furniture Company contemplates the installation of a new power plant, which will be equipped with a dynamo and engine rated at 200 hp, with condenser, exciter, boilers, pumps, feed-water heater, etc.

RACINE, WIS.—Preparations are being made by the American Seating Company, of Racine, Wis., for the construction of a new power plant and factory buildings. The equipment required will include three water-tube boilers, Corliss engine, generator, motors, pumps, etc.

SHEBOYGAN, WIS.—Preparations are being made by J. M. Kohler Sons Company, of Sheboygan, Wis., for the installation of electrically driven centrifugal pumps for fire protection.

SHEBOYGAN, WIS.—The Sheboygan Light, Power & Railway Company is reported to have decided to install a 1000-kw steam turbine and generator in its plant. The new unit, it is said, will be purchased about Jan. 15.

SPARTA, WIS.—Preparations are being made for the installation of a power and heating plant at the Monroe County buildings at Sparta, Wis. The equipment will include boilers for a 250-hp automatic engine, electric generator and some small motors. For further information address Chandler & Park, Racine, Wis.

WAUSAU, WIS.—The City Council is considering the construction of a new pumping station, which will probably be equipped with motor-driven centrifugal pumps.

EDMONTON, ALB., CAN.—Engineers who have been making investigations of the upper Saskatchewan River for the purpose of power development have decided upon a site for the proposed plant located about 110 miles from Edmonton, where it is estimated that a maximum of 20,000 hp. can be developed at a cost of about $1,500,000. It is understood that Montreal capitalists will become associated with local

interests which are identified with the project. Charles Tupper, B. Sc., of McGill University, and Charles H. Colgross, M. E., have been making the investigations.

PRINCE RUPERT, B. C., CAN.—The Grand Trunk Pacific Railroad Company is fitting up a temporary electric plant on the wharf to supply its office buildings with electricity for lamps, until the plant at Seal Harbor, recently destroyed by fire, is rebuilt.

PRINCE RUPERT, B. C., CAN.—The British Columbia Provincial Government has declined to advance $75,000 to the municipality of Prince Rupert for the installation of an electric lighting plant. The private electric lighting plant at that place was destroyed by fire a short time ago.

PRINCE RUPERT, B. C., CAN.—The Board of Trade is agitating the installation of a civic lighting plant. It is not expected that anything will be accomplished as it is probable that the Columbia Tie & Timber Company's saw mill at Seal Harbor will be rebuilt and a larger electric lighting plant installed in connection with it.

BRANTFORD, ONT., CAN.—Application has been made to the Council by T. R. Varding, of Buffalo, N. Y., for a franchise to construct and operate an electric railway in the Township of Brantford.

HAMILTON, ONT., CAN.—The City Council has awarded the contracts for electrical equipment for the pumping plant at the Beach, which includes the installation of two 500-hp motors, with all equipment, two transformers and pumps. The Westinghouse Company secured the contract for motors and transformers, at $16,624, and the John McDougall Caledon Iron Works Company for pumps, at $7,220. The Westinghouse Company was also awarded the contract for motors, pumps and other equipment for the annex sewage disposal plant, at $4,000.

LONDON, ONT., CAN.—Announcement has been made that the London & Lake Erie & Transportation Company contemplates improvements to its system, which will involve an expenditure of about $150,000. The company is successor to the Southwestern Traction Company.

PORT ARTHUR, ONT., CAN.—An extension four miles in length will be built by the Port Arthur & Fort William Electric Railway during 1910. N. C. Pilcher is purchasing agent.

MONTREAL, QUE., CAN.—At an election held Dec. 21 the property owners voted in favor of establishing a municipal electric light plant. The election is not regarded as having any special value, as out of 20,000 qualified voters only about 2800 voted.

SHERBROOKE, QUE., CAN.—The City council has approved a by-law granting the Sherbrooke Street Railway Company a 40-year franchise, under the terms of which the city will have the privilege of purchasing the property at the end of 20 years. The railway will be extended as soon as additional power is developed.

QUEBEC, QUE., CAN.—It is reported that the Quebec Railway, Light & Power Company will soon place contracts for the construction of a substation at Ste. Anne de Beaupre. The company has submitted a proposition to the Council of Montcalmville for the extension of its tracks from the boundary of the City of Quebec through the municipality to Cape Rouge and St. Foye Church.

GUADALAJARA, MEX.—Plans have been prepared by the Chapala Hydro-Electric & Irrigation Company, of Guadalajara, Mex., for the construction of an electric railway to connect Guadalajara with Chapala, on the northern shore of Lake Chapala, a distance of about 32 miles. Emilio Pinzon is manager.

ZACATECAS, MEX.—The Cia. Electricia de Zacatecas has applied to the State authorities for an amendment to its present charter, which will enable the company to increase its service and extend its system. The company asks for permission to erect transmission lines into neighboring towns to supply electricity for lamps and motors. If authority is granted the company will enlarge its generating plant.

New Industrial Companies.

THE AMERICAN HYDRO-NUMATIC COMPANY, of New York, N. Y., has been chartered with a capital stock of $100,000 for the purpose of manufacturing machinery by C. M. Gilpin, W. M. Alberti and H. M. Gaylord, of New York, N. Y.

THE AUTOMATIC STREET RAILWAY SWITCH COMPANY, of Camden, N. J., has been incorporated by A. M. Haldeman, J. G. Ryan and C. Blake, of Philadelphia, Pa. The company is capitalized at $50,000 and proposes to manufacture automatic railway switches.

THE CONSTANTINE CONSTRUCTION COMPANY, of Buffalo, N. Y., has been incorporated with a capital stock of $25,000 as general contractors. The incorporators are: Dennis J. Constantine, John S. Constantine and Patrick Constantine, all of Buffalo, N. Y.

THE CUTHBERT TRANSMISSION SYNDICATE, of Atlantic City, N. J., has filed articles of incorporation with a capital stock of $75,000 for the purpose of manufacturing power transmission appliances. The ncorporators are: E. F. Hall, H. A. Locha and A. F. Hall, of Atlantic City, N. J.

THE ELECTRICAL ENGINEERS' EQUIPMENT COMPANY, of Chicago, Ill., has been chartered with a capital stock of $10,000 for the purpose of doing a general electric and contracting business by J. T. Tyrrell, J. B. Dunn and P. Steele.

THE ELECTRIC STEEL ALLOYS COMPANY, of Wilmington, Del., has been incorporated with a capital stock of $1,000,000 by F. M. Shive, S. E. Robertson and H. W. Davis, of Wilmington, Del.

THE ELEVATOR & MACHINERY MAINTAINING COMPANY, of New York, N. Y., has filed articles of incorporation with a capital stock of $25,000. The company proposes to do electrical work of all kinds. The incorporators are: J. J. Cole, of Jersey City, N. J.; W. W. Bridgeman, of Nutley, N. J.; and A. Annis, Borough of Bronx, New York.

THE FRIEDERICH ELECTRIC & MANUFACTURING COMPANY, of New York, N. Y., has been incorporated by J. J. Sullivan, H. E. von Pein and T. Faber, of New York, N. Y. The company is capitalized at $60,000 and proposes to manufacture X-ray tubes, interrupters, etc.

THE KEYSTONE CONTRACTING COMPANY, of New York, N. Y., has been chartered with a capital stock of $50,000 for the purpose of doing a general contracting business, building docks, railroads, subways, etc. The incorporators are: Robert H. Hibbard, Francis J. McCann, of New York, N. Y., and William S. Carter, of St. Louis, Mo.

THE MARKIMSEE METER COMPANY, of New York, N. Y., has been incorporated with a capital stock of $100,000 by F. R. Kimbley, B. L. Seelye and A. J. Marshall, of New York, N. Y. The company proposes to manufacture meters and motors.

THE MARSH-CAPRON MANUFACTURING COMPANY, of Chicago, Ill., has been incorporated with a capital stock of $100,000 for the purpose of manufacturing machinery. The incorporators are: Herbert D. Crocker and Gilbert Noxon, both of Chicago, Ill.

THE PORTSMOUTH MANUFACTURING & POWER COMPANY, of Kittery, Me., has been incorporated with a capital stock of $50,000. The company proposes to manufacture machinery and tools. The officers are: J. K. Bates, president, and C. W. Brewster, treasurer, of Portsmouth, N. H.

THE SOUTH SIDE CHANDELIER COMPANY, of Chicago, Ill., has been incorporated by S. Burns, Jacob L. Burgard and A. B. Shaw. The company is capitalized at $2,500 and proposes to do a general electrical construction and installation business.

THE S. K. F. BALL BEARING COMPANY, of New York, N. Y., has been incorporated with a capital stock of $50,000 by Samuel T. Hubbard, of Yonkers, N. Y.; Frederick H. Poor, of Buffalo, N. Y., and Myron Grennell, of Waymart, Pa. The company proposes to do a general mechanical and electrical engineering business.

THE UNION LIGHT & SUPPLY COMPANY, of Chicago, Ill., has been chartered with a capital stock of $5,000 to deal in manufactured products and patents. The incorporators are: S. L. Page, J. B. Lewis and R. M. Shaw.

THE UNITED SERVICE COMPANY, of New York, N. Y., has been chartered by G. Bullock, S. J. Dill, and H. Morgan, of New York, N. Y. The company is capitalized at $100,000 and proposes to do a general contracting and construction business.

New Incorporations.

OAKLAND, CAL.—Articles of incorporation have been filed for the People's Light & Power Company with a capital stock of $500,000. The company is an adjunct of the Great Western Power Company, organized for the purpose of local distribution of electricity for lamps and motors. The directors are: D. U. Toffelmeier, of San Leandro, Cal.; J. H. Hornung, A. C. Sprout, F. H. Woodward and W. H. Spaulding, all of Oakland, Cal.

SAN FRANCISCO, CAL.—Articles of incorporation have been filed for the Mount Shasta Power Company with a capital stock of $1,000,000. The company proposes to unite a large number of individual claims along the Pitt River and proposes to expend $2,000,000 in developing the property. The incorporators are: William A. Cooper, R. C. Johnson, of San Francisco, Cal.; John C. Hays, of Visalia, Cal.; H. V. Gates, of Hillsboro; Jesse A. Lilienthal, Albert Raymond and C. J. Treat, of San Francisco, Cal.

SAVANNAH, GA.—The Savannah Hydro-Electric Company has been incorporated with a capital stock of $300,000 for the purpose of constructing a hydroelectric power plant on the Connooche River, 40 miles from Savannah, by G. H. Miller, S. J. Platsch and others of Savannah, Ga. D. Z. Zeigler & Company, of Jacksonville, Fla., are engineers.

LERNA, ILL.—The Lerna Telephone Company has filed articles of incorporation with a capital stock of $3,000. The incorporators are: R. G. Hall, S. O. Beale and M. C. Wortham.

LOUISVILLE, KY.—The Southern Hydro-Electric Company has filed articles of incorporation with a capital stock of $6,000 by George G. Fetter, J. H. Cochran and Wallace Hoeing, all of Louisville, Ky., and others. The company proposes to develop the water power of the Dix River.

CHILHOWEE, MO.—The Chilhowee Telephone Company has been chartered with a capital stock of $2,000 by J. E. Cahill, S. R. Sweeney, C. H. Gains and others.

KALISPELL, MONT.—The Bitter Root Mountain Water Power Company has been incorporated with a capital stock of $100,000 for the purpose of developing electricity in the Flathead Valley. C. A. Farrar and others are the incorporators.

ORANGE, TEX.—The Orange Home Telephone Company has been incorporated with a capital stock of $40,000 by William D. Dean, John B. Fletcher, Hugh L. Runkle, Allen Edwards, H. M. Shingle and E. L. Bruce.

UVALDE, TEX.—The Uvalde & Leona Valley Interurban Railway Company has been incorporated by Charles Peterson, A. M. Avant and M. M. McFarland. The company is capitalized at $50,000 and proposes to construct an interurban railway connecting Uvalde and Sansom.

ALEXANDRIA, VA.—Articles of incorporation have been filed for the Roanoke Electric Light & Power Company with a capital stock of $1,000,000 for the purpose of developing the water power of the Roanoke River and tributaries. The officers are: M. Coffman, of Woodstock, Va.; I. T. Stoneburner, secretary and treasurer, of Edinsburg, Va. The directors are: M. Funkhouser, C. C. Skyles and E. C. Geary, all of Woodstock, Va.

Personal.

MR. EUGENE CREED has been appointed assistant sales and advertising manager of the Toronto Electric Light Company, Limited.

MR. HERBERT W. RIDGELY has been appointed superintendent of the Alexandria Electric Light & Power Company, of Alexandria, Va., to succeed Mr. T. C. Roderick.

MR. HARRY H. MORRELL, formerly constructing engineer with the Electric Storage Battery Company, has been appointed manager of the Tate Accumulator Company of Canada, Toronto, Ont.

MR. R. D. APPERSON, president of the Lynchburg (Va.) Traction & Light Company, was presented on Dec. 11 with a handsome silver dish by employees on the occasion of their annual supper.

MR. W. B. MacDONALD, who recently resigned as vice-president and manager of the Evansville Gas & Electric Light Company, of Evansville, Ind., has been appointed manager of the new Public Service Corporation in that city.

MR. B. R. SHOVER has been transferred to the position of electrical engineer of the Youngstown District, Carnegie Steel Company, with address at Youngstown, Ohio, from a similar position with the Indiana Steel Company.

MR. H. P. PAGE, of Baltimore, has been engaged to make an examination of the books of the Ft. Wayne (Ind.) municipal lighting plant in view of charges that the service supplied is more costly than that furnished by private corporations.

MR. ROBERT J. McCUEN, superintendent of the department of lamps and lighting of Baltimore, Md., has returned to his desk after an illness of six weeks, during part of which period Mr. McCuen directed over the telephone the more important business of his department.

MR. ARTHUR N. CANTRIL, formerly with the Denver Gas & Electric Company, and more recently with the Pueblo Gas Company, has been made general manager of the Spokane Gas Light Company, which was recently acquired by the Doherty interests.

MR. E. A. WAKEMAN, until recently general manager of the Citizens' Gas & Fuel Company, of Terre Haute, Ind., has accepted an appointment as general superintendent of the Susquehanna Railways, Light & Power Company, with headquarters in New York City.

MR. ROBERT C. HOUSE, formerly of the sales department of the Safety Insulated Wire & Cable Company, has accepted a position with the Sprague Electric Company, 527 West Thirty-fourth Street, New York City, N. Y., in its motor and generator sales department.

MR. WALTER LORING WEBB, C. E., has become associated with the Roberts & Abbott Company, Inc., consulting, supervising and operating engineers, Cleveland, Ohio. Mr. Webb will represent the company in Philadelphia and vicinity, with offices in the Real Estate Trust Building.

MR. W. S. TAUSSIG, until recently a manufacturer's agent in Chicago, has accepted a position with the Chicago office of the General Electric Company, where he will be connected with the power and mining department. Mr. Taussig is secretary of the Electric Club of Chicago.

MR. GEORGE R. WILLIAMS has been appointed division superintendent of the Eastern Pennsylvania Railways Company, with office at Lansford, succeeding Mr. J. C. Bell, whose promotion is announced elsewhere in this column. Mr. Williams was formerly train master at the main office at Pottsville, Pa.

MR. GEORGE G. WARD, vice-president and general manager of the Commercial Cable Company, was presented on Dec. 27, by the employees of the company, with a beautiful silver centre-piece as a testimonial of their regard for him. The design of the centre-piece is emblematical of the nature of the company's business and is a work of art.

MR. J. C. BELL, division superintendent of the Eastern Pennsylvania Railways Company, stationed at Lansford, Pa., has been promoted to the position of superintendent of railways with office at Palo Alto, in charge of transportation and roadway departments. Mr. Bell succeeds Mr. C. E. Palmer, whose resignation was announced in the *Electrical World* of Dec. 23.

MR. B. J. ARNOLD was married on Dec. 22 in New York City to Mrs. Margaret Latimer Fonda. The bride, who has during her residence in New York City the past seven years devoted much of her time to charity work in connection with the St. Thomas Episcopal Church, is a member of the Women's Club, the Rubinstein Club and the Daughters of the British Empire.

MR. C. W. WETMORE, former president of the North American Company, has resigned from the board of directors of the Union Electric Light & Power Company. Mr. James Campbell, the new president of the North American, has been elected to the board in Mr. Wetmore's place. Alten S. Miller, vice-president and general manager of the Union Electric, will probably be elected president in a few weeks.

MR. L. E. HOLDERMAN, of Terre Haute, Ind., has resigned as assistant general manager of the Terre Haute, Indianapolis & Eastern Traction Company to become secretary and manager of the new Central States Tie & Gravel Company, of Terre Haute. Mr. Holderman was formerly connected with the Eastern Wisconsin Railway & Light Company, of Fond du Lac, Wis., and has a wide experience both in the railway field and in central-station service.

MR. J. S. CORBY, assistant manager for the Bryan-Marsh Company in Chicago, has resigned to become manager of sales of the Monarch Incandescent Lamp Company. The latter is a new company incorporated under the laws of Ohio, with headquarters in Chicago, to manufacture and sell all kinds of electric incandescent lamps. It is licensed by the National Electric Lamp Association, and Fairbanks, Morse & Company are the sole distributors of its output. Mr. Corby, who is well-known in the incandescent-lamp field, will have his office at 481 Wabash Avenue, Chicago.

MR. FREDERIC H. KEYES, formerly general manager of the Robb-Mumford Boiler Company, has associated himself with Messrs. Timothy W. Sprague, Henry Docker Jackson and others to carry on a general consulting engineering business under the name of Timothy W. Sprague, Frederic H. Keyes, Henry D. Jackson and Associates, 88 Broad Street, Boston, Mass. The firm will make complete reports and investigations, and furnish designs and supervision for all sorts of power plants for lighting, railway or industrial purposes; also mining reports, investigations and power plants. The combination takes place on Jan. 1, 1910.

MR. P. O. KEILHOLTZ, who has been for over 20 years consulting engineer for the railway and lighting properties of Baltimore, Md., has opened an office as consulting engineer in the Continental Building of that city. Mr. Keilholtz has been closely identified with most of the important electrical work planned and constructed in Baltimore during the last 20 years. He is a graduate of the United States Naval Academy, and after resigning from the navy took a post-graduate course at the Johns Hopkins University. Mr. Keilholtz has just been commissioned to prepare the plans and supervise the construction of a power plant at Millville, Va., for the Winchester & Washington City Railway Company.

MR. RICHARD E. SLADE, who will become general manager of the gas and electric departments of the New Orleans Railway & Light Company on Jan. 1, has long been identified with the gas lighting industry, but has had considerable experience with electrical properties as well. Previous to entering upon his present duties as treasurer and general manager of the Hartford City Gas Light Company, in 1904, for three years he was superintendent of the Lockport Gas & Electric Light Company—now the Lockport Light. Heat & Power Company. Mr. Slade was born at Yonkers, N. Y., in 1865. He was graduated from the Columbia School of Mines in 1887 and was appointed assistant superintendent of the Yonkers Gas Light Company. Subsequently he was placed in charge of the gas works at Asheville, N. C., and later was connected with the gas and electric company at White Plains, N. Y.

Obituary.

PROF. FRANK J. SHORT, for a time in charge of engineering research at Cornell University, died in Fort Collins, Col., Dec. 22, of tuberculosis. Professor Short was graduated from the University of Wisconsin in 1897.

MR. DUMONT CLARKE, director of the Commercial Cable Company, the Commercial Cable Company of Cuba, the Long Island Consolidated Electrical Company, Long Island Railway Company, and numerous other companies engaged in industrial undertakings, died on Dec. 26 at his home in Dumont, N. J. Mr. Clarke was 69 years old. He came of a family of bankers and had been president of the American Exchange National Bank, New York, since 1893.

MR. FRED LESLIE, superintendent of the Muncie Electric Light Company, of Muncie, Ind., and well known to electrical men of the Middle West, died of typhoid fever on Oct. 17. Mr. Leslie was secretary of the Indiana Electric Light Association, the formation of which was largely due to his efforts, and he was popular among his fellow central-station men. He was but a young man, and his untimely and unexpected death is deeply regretted by a wide circle of friends.

MR. J. F. McCUSKER, for five years assistant city electrician of Denver, died on Dec. 21 from an acute attack of double pneumonia after an illness of only four days. Mr. McCusker was a pioneer in the electrical history of the West, gaining his original training in the Brush and Thomson-Houston works. To him is due much of the credit for the development in the last few years of Denver's interior wiring requirements until it now ranks among the first few cities of the country.

DR. CHARLES R. DUDLEY, president of the American Society for Testing Railway Materials, international president of the Society for Testing Materials, and president of the American Chemical Society,

died at Altoona, Pa., on Dec. 21. Dr. Dudley received his degree from Yale University. He was chief chemist of the Pennsylvania Railroad Company, and was well known among railway men, chemists and scientists. One of his most important contributions to scientific knowledge was his investigation of the composition of steel rails.

Trade Publications.

TACHOMETERS, of the magneto-generator type, designed for marine use, are illustrated and fully described in bulletin No. 33 of the Industrial Instrument Company, Foxboro, Mass.

DIMMER FOR INCANDESCENT LAMPS.—The Anylite Manufacturing Company, Newbery, Ore., has issued a folder devoted to an attachment to be inserted between an incandescent lamp and its socket for the purpose of regulating the light given by the lamp.

ARC LAMPS.—A bulletin of the Allgemeine Elektricitäts-Gesellschaft, Berlin, Germany, gives illustrations and brief outline description of flaming arc lamps for direct-current and alternating-current circuits. These lamps are arranged with particular reference to street lighting.

ARC LAMPS.—Circular No. 1506 of the Westinghouse Electric & Manufacturing Company, Pittsburgh, Pa., contains a reprint of a paper by Mr. C. E. Stevens, entitled "Recent Types of Arc Lamps and their Operation," read before the National Electric Light Association in June, 1909.

ELECTRIC VEHICLES.—The Fritchle Automobile & Battery Company, Denver, Col., has issued a well-illustrated booklet describing in detail a 2140-mile tour made in a Fritchle "100-mile" electric vehicle in winter from Lincoln, Neb., to New York City, thence to Washington, D. C.

RECORDING GAGES.—Bulletin No. 117 of the Bristol Company, Waterbury, Conn., describes and illustrates recording gages for pressure and vacuum and also water-level gages. In these gages there are no multiplying devices, the recording pen arm being attached directly to the pressure tube.

TUNGSTEN LAMPS.—Users of electricity for illuminating purposes will be interested in a booklet issued by the General Electric Company, entitled "A Revolution in Lighting Due to a New Lamp," and numbered 3841. This booklet tells in a simple way the advantages to be derived from the use of the tungsten lamp.

VACUUM CLEANERS, designed for operation by means of electric motors, are well discussed in a booklet issued by the Keller Manufacturing Company, Philadelphia, Pa. These cleaners are of the portable type intended for residence service. Cleaners for hotel service of the portable and stationary types are described in bulletins Nos. 30 and 32 of the same company.

WESTERN ELECTRIC MOTORS AND GENERATORS.—The Western Electric Company has published a new edition of its bulletin No. 5131, which shows in detail its type IL of motors and generators. A new edition has also been issued of bulletin No. 5132, taking up the type ELC motors of interpole design.

POLYPHASE INDUCTION MOTORS.—The General Electric Company has issued bulletin No. 4674, illustrating and describing its polyphase induction motors and the controlling apparatus for use with them. An interesting illustration in this bulletin is that of a 6000-hp, 6600-volt induction motor installed at Gary, Ind.

ARC LAMPS.—The American Flaming Arc Lamp Company, 148 Purchase Street, Boston, Mass., has issued an illustrated bulletin devoted to flaming arc lamps. Complete descriptions are given of the controlling devices and operating characteristics, while directions for installing and trimming the lamps are also included. The company has issued an illustrated price-list of rates of these lamps.

VOLTAGE REGULATION.—Two folders of special interest to central station managers, and referring to the voltage regulation of feeder circuits and generator circuits, are being issued by the General Electric Company under numbers 3846 and 3847, respectively. These folders describe briefly the apparatus used in accomplishing this regulation, and state the advantages to be derived from its use.

GRAPHITE AS A LUBRICANT.—The Joseph Dixon Crucible Company, Jersey City, N. J., has issued a new edition, the eleventh, of its well-known treatise upon the theory and practice of graphite lubrication. The matter is treated in seven chapters covering 59 pages and the matter is given concentrated and convenient form. The greater part of the pamphlet deals especially with the lubrication and treatment of power house machinery.

OXHYDRIC CUTTING.—The American Oxhydric Company, Milwaukee, Wis., has issued a bulletin devoted to the "Oxhydric" process for the cutting and welding of metals by means of oxygen and hydrogen. This process is based on the well-known fact that metals made intensely hot burn easily and rapidly in an atmosphere of oxygen gas. An illustration is given of the cutting of a 9-in. nickel-chrome plate at the rate of 5 lin. in. per minute.

ELECTRIC DRIVE FOR PRINTING PRESSES.—The managers of printing establishments should be interested in bulletin No. 4672 of the General Electric Company and entitled "Electric Drive for Large Printing Presses," inasmuch as it has to do with a subject of vital importance to the up-to-date printer. This bulletin refers to certain electrical installations used in connection with this work, and describes the most modern method of operation and control of large presses.

MODERN SANITARY CLEANING.—This pamphlet, which of course treats of vacuum cleaning machinery, is issued by the Palm Engineering Company of Detroit, Mich. In it is contained a short illustrated description of the company's system for removing dust and dirt. A reciprocating pump is employed for creating the vacuum and the clearance space between the piston and the cylinder is filled with a flowing water packing. This not only serves as lubrication but makes possible the elimination of wet and dry separators, the finer particles of dust being drawn into the cylinder and discharged into the sewer with the water.

MAGNETO NON-MULTIPLE SWITCHBOARDS.—The Western Electric Company has issued for general distribution bulletins Nos. 1001 and 1002, which take up in detail the construction and operating features of magneto non-multiple switchboards, with self-restored and manually restored line signals. They contain illustrations of the different essential parts of line-circuit apparatus, cord-circuit apparatus as well as different styles of switchboards. Numerous diagrams are also shown illustrating the wiring connections for the various parts. These bulletins are the first of a series of 10 switchboard bulletins which are to be issued by the Western Electric Company describing its newest and latest designs of switchboards and telephone apparatus and will be sent to any address on request.

Calendars.

THE ELECTRIC APPLIANCE COMPANY, Chicago, has issued a pocket-size celluloid calendar card covering the whole of the year 1910. On the reverse side are shown the Packard lamp and the Sangamo watt-hour meter.

THE DEARBORN DRUG & CHEMICAL WORKS, 225 Postal Telegraph Building, Chicago, is distributing a wall calendar for office use, in connection with which attention is called to the Dearborn scientific water treatment for preventing corrosion and pitting of boilers.

THE MITCHELL-RAND MANUFACTURING COMPANY, New York, has prepared for its customers and friends a calendar of generous proportions containing the one word "Insulation" in addition to the name of the firm. Besides showing the phases of the moon for the month, each sheet contains a miniature calendar covering the previous and the succeeding months.

Business Notes.

BARLOW & JOHNSTON is the name of the new electrical contracting and engineering firm of Baltimore, Md. Mr. Barlow was for years associated with the Highland Electric Company, of that city.

DOSSERT PRODUCTS IN SOUTH AFRICA.—Dossert & Company, of New York, have concluded an arrangement through the Western Electric Company whereby the last named company's representative, Mr. J. W. Keefe, at Johannesburg, will act as sole agent for Dossert connectors in South Africa. Mr. Keefe has just cabled orders for 2,500 Dossert connectors of various types to be used in extensive electrical installations in South African mines.

THE WESTINGHOUSE BALTIMORE BRANCH is conducting an active campaign for new business, including some very clever advertising, with demonstrations in the large show window of its handsome Baltimore Street store. Not only are these public demonstrations given in the store of the company, but they are also held in the shops of some of the most prominent supply dealers. In conjunction with this the company has issued an illustrated descriptive folder to every consumer of electric current in the city, which has met with quick results and has been the means of causing a quantity of Westinghouse toasters and heaters to be sold for Christmas presents.

OHIO BRASS COMPANY'S SALES AGENTS.—The Ohio Brass Company, Mansfield, Ohio, has appointed the Holabird-Reynolds Company, of San Francisco, Holabird-Reynolds Electric Company, of Los Angeles, and Holabird Electric Company, of Seattle, as exclusive sales agents for O-B Hi-Tension porcelain insulators in the States of California, Oregon and Washington. Pierson, Roeding & Company, with offices at San Francisco, Los Angeles and Seattle, will continue to be exclusive sales agents for Ohio Brass overhead material, rail bonds, car equipment specialties and catenary material, including such special porcelain insulators as are used in catenary construction. The Hendrie & Bolthoff Manufacturing & Supply Company, of Denver, Col., has been appointed special sales agent for the company for materials for the mining trade in Colorado, Wyoming, Utah, Arizona and New Mexico, as well as for certain railway properties located in the mining districts of this territory. The business of railway and mining companies located at Salt Lake City, Denver, Cheyenne, Colorado Springs, Pueblo and Telluride will be, as heretofore, handled by the Brass Company's regular salesman, Mr. F. V. Cook, who will also give special attention to Hi-Tension Insulator business in all five of the States mentioned. Mr. J. C. Barr, 84 State Street, Boston, Mass., has been appointed Boston sales agent and will solicit business in all of the New England States with the exception of Connecticut. Mr. R. G. Campbell, of the New York office, will continue to visit the trade in Connecticut in addition to his other territory.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED DEC. 21, 1909.

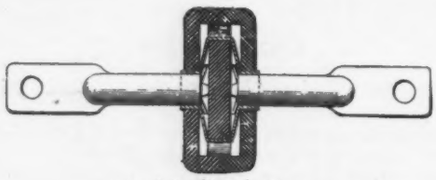
[Conducted by W. F. Bissing, Patent Law, 2 Rector St., N. Y. City.]

943,647. BURGLAR-PROOF LOCK; I. L. Bridges, Powersville, Mo. App. filed April 10, 1909. This invention is a safety device adapted to be applied to locks of bank, vault or safe doors and is designed to cause an electric current to pass through the lock should the same be tampered with during a predetermined period of time.

943,681. SEPARABLE ATTACHMENT-PLUG; Harvey Hubbell, Bridgeport, Conn. App. filed June 5, 1908. A separable attachment-plug of simplified construction.

943,697. MAGNETO ELECTRIC MACHINE; T. M. Mueller, Dalton, Mass. App. filed Feb. 25, 1909. A machine designed for ignition of the gaseous charge in an internal combustion engine. It is of the inductor alternator type.

943,698. ELECTRIC FUSE; T. E. Murray, New York, N. Y. App. filed Feb. 8, 1909. A fuse comprising two separated members con-



943,658—Electric Fuse.

stituting circuit terminals having a partition of insulating material therebetween.

943,699. SWITCHBOARD AND CUT-OUT; T. E. Murray, New York, N. Y. App. filed June 1, 1909. This device consists of a series of units, each unit comprising a block of refractory insulating material mutually crossing circuit conductors and means operable from the exterior of the unit for electrically connecting the conductors therein and at their crossing points.

943,721. ELECTROPLATING TANK; G. L. Wallace, Bridgeport, Conn. App. filed April 1, 1909. An electroplating device of the tumbler type so constructed that the movable receptacle for retaining the work to be plated can be readily removed or replaced.

943,772. INCANDESCENT LAMP SOCKET; L. Dorner and G. H. Norquist, Denver, Col. App. filed Dec. 11, 1908. The socket consists of separable sections which may be readily detached and is provided with means for locking the sections in assembled positions.

943,809. RAILWAY ELECTRIC SWITCH; R. B. Bryant, Nashville, Ark. App. filed Feb. 11, 1908. This device is designed to enable a motorman to open or close a railway switch without leaving the car. It is devoid of relays, circuit changers and other auxiliary apparatus usually employed in automatic electric railway switches.

943,831. TWO-POLE SNAP SWITCH; L. Kellner, New York, N. Y. App. filed Nov. 17, 1908. A wall switch designed to be substantially flush with the surface of the wall and includes a two-button snap switch by which a circuit or plurality of circuits are controlled.

943,861. ELECTRIC WELDING MACHINE; A. E. Buchenberg, Toledo Ohio. App. filed March 26, 1909. A welding machine in which the levers carrying the work-clamping jaws are permitted to have free relative lateral movements as required without disconnecting the jaw-carrying levers and also provided with means adapted to permit the said levers to have relative oscillatory movement.

943,883. ELECTRICAL SIGNALING AND SWITCHING APPARATUS; R. H. Manson, Elyria, Ohio. App. filed May 29, 1907. A combined self-restoring drop and jack, consisting of a tubular iron-clad electromagnet, a drop shutter controlled thereby, a spring jack and a long spring movable with one of the jack springs when a plug is inserted to push up and restore the drop shutter.

943,914. SWITCH INDICATOR; C. A. Clark, Hartford, Conn. App. filed Sept. 21, 1908. An indicator designed to be applied to the cover of a switch mechanism in predetermined relation of parts so that the registrations of the dial of the indicator will always correctly show the position of the parts of the switch mechanism.

943,918. ELECTRICAL MEDICAL APPLIANCE; B. R. Davenport, Philadelphia, Pa. App. filed May 15, 1908. A device adapted to subject a portion of the body of a person to an electric current intermittently whereby different portions of the body may be subjected to an electric current intermittently and in prescribed order and whereby the intensity of the current may be regulated.

943,924. ELEVATOR SIGNAL; B. E. Fanning, Los Angeles, Cal. App. filed Sept. 11, 1907. A signal designed to be used on passenger elevators which will immediately notify the operators in the elevator cars of any intending passenger the floor he is waiting on and the direction in which he wishes to be taken, and a system whereby the call is immediately retracted when any operator answers it.

943,931. DAMPER REGULATOR; F. C. Guptill, Elgin, Ill. App. filed Nov. 9, 1908. A thermostatically actuated automatic damper regulator for controlling the combustion in furnaces, steam generators or hot-water boilers.

943,933. ELECTRIC CLOCK SYSTEM; H. O. Harrison, Wichita, Kan. App. filed March 16, 1908. A clock system under the control of a master clock, which causes the periodic sending to the line of electrical impulses, which in turn actuate the local clocks all at the time and to the same extent, the duration of the impulses being very short, as compared with the time period between said impulses.

943,940. THEATER CHAIR SIGNAL SYSTEM; P. T. Kenny, New York, N. Y. App. filed Nov. 24, 1908. A system connecting the theater seats with the office whereby the person in the office can tell at any time what seats in the house are vacant.

943,958. FLUSH PLATE FOR FLUSH RECEPTACLES; F. T. Wheeler, Plainville, Conn. App. filed Dec. 7, 1906. A flush plate for flush receptacles adapted to protect the parts of the receptacle, yet permitting of easy access to its interior.

943,960. SYSTEM OF DIRECTED WIRELESS TELEGRAPHY; E. Bellini and A. Tosi, Paris, France. App. filed Oct. 1, 1907. A wireless system employing electromagnetic waves and which permits a receiving station provided with a plurality of dirigible aerials to radiate mainly in any given direction without it being necessary either to turn the aerials or to employ a great number thereof.

943,969. SPACE TELEGRAPHY; L. De Forest, New York, N. Y. App. filed Jan. 29, 1907. A space telegraphy system provided with a discharger for an opened or closed circuit, an electrical condenser which shall permit of a regular and constant spark frequency.

944,003. ELECTRIC SIGNAL SYSTEM; A. L. Sohm, Los Angeles, Cal. App. filed Sept. 24, 1907. A system provided with electrical connections with outlying signal stations and having means to automatically disconnect such station from the signal, indicating means after a signal has been sent from any signal station until the signal indicating means is reset.

944,040. OVERLOAD AND REVERSE CURRENT RELAY; P. O. Keilholtz, Baltimore, and F. E. Ricketts, Derwood, Md. App. filed Aug. 5, 1908. A device designed to protect electrical apparatus included in an alternating circuit by means of an overload and reverse-current relay.

944,050. ELECTRICAL STEAM GENERATOR; E. I. Rains, New York, N. Y. App. filed Feb. 11, 1909. An electrical steam generator having a common casing, a plurality of independent water containers therein, each communicating with a common steam space, and a plurality of independent electrical heating elements in each container.

944,060. RHEOSTAT; H. L. TRUESDALE, Somerville, Mass. App. filed Aug. 20, 1909. A rheostat wherein the resistant material is fluid instead of metal, the electrodes being submerged in the fluid, and adapted to move in closer relation to each other.

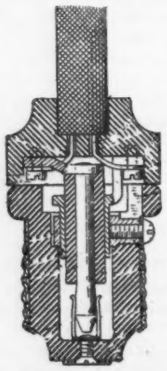
944,061. ELECTRICAL MEASURING INSTRUMENT; T. W. Varley, New York, N. Y. App. filed Feb. 3, 1906. A measuring instrument wherein a movable element is employed in connection with a shifting or changing field adapted to impart movement to said movable element and a substantially constant field adapted to retard the movement of the movable element by inductive action.

944,078. COUPLING FOR BATTERY ELEMENTS; F. A. Decker, Philadelphia, Pa. App. filed Oct. 5, 1906. A coupler whereby a close engagement is automatically maintained, the parts insulated so that a metal envelope can be used in the cell and the destruction due to the electrochemical action greatly reduced.

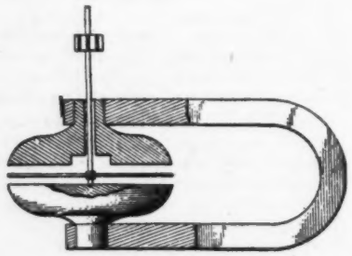
944,079. ELECTRIC BATTERY; F. A. Decker, Philadelphia, Pa. App. filed June 20, 1907. An electric battery comprising a vessel in which there is a plurality of removable cells, each having a resistance duct connecting its interior with the interior of the vessel.

944,131. OVERHEAD SWITCH FOR ELECTRIC RAILWAYS; E. E. Gilmore, Philadelphia, Pa. App. filed Sept. 27, 1905. A switch designed to obviate as far as possible the excessive wear.

944,139. ELECTRODE FOR ELECTRIC ARC LAMPS; A. D. Jones, Holloway, London, Eng. App. filed April 18, 1908. An electrode



943,681—Separable Attachment Plug.



944,061—Electrical Measuring Instrument.

for electric arc lamps of the enclosed type carrying a mixture of calcium tungstate and calcium flourid, and a steadying salt of an alkali metal.

944,167. INDUCTION SUPPLY METER FOR POLYPHASE ELECTRIC CURRENTS; H. Aron, Charlottenburg, Germany. App. filed July 28, 1908. A supply meter in which the space occupied by the apparatus is reduced by making the iron cores of the electromagnet of both sets of driving coils in one piece, so that the magnetic lines of force of both sets pass partly together through the same portion of the iron.

944,186. OVERHEAD CONSTRUCTION FOR ELECTRIC RAILWAYS; E. E. Gilmore, Philadelphia, Pa. App. filed July 18, 1907. A switch adapted to maintain a balance of strains between switch and guy wires and also arranged so that the branch trolley wire will throw no strain on the main wire.

944,208. ELECTRIC LAMP SOCKET; F. P. Poole, Bridgeport, Conn. App. filed Sept. 21, 1909. A socket designed to give a double brake with the key is turned to cut out the current.

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Electrical World

WITH WHICH ARE INCORPORATED

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ANTWERP: Bell Telephone Manufacturing Co.
LONDON: Western Electric Company.
BERLIN: Telephon Apparat Fabrik. E. Zweitusch & Co.
PARIS: Société de Matériel Telephonique

Alphabetical Index and Classified Directory second page following reading

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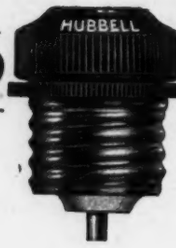

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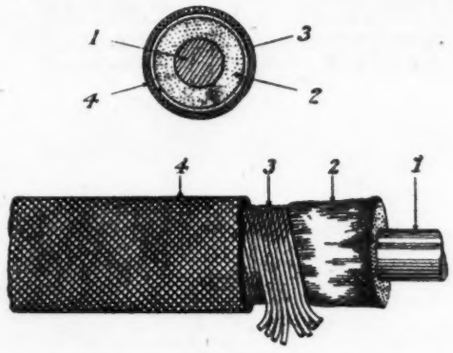

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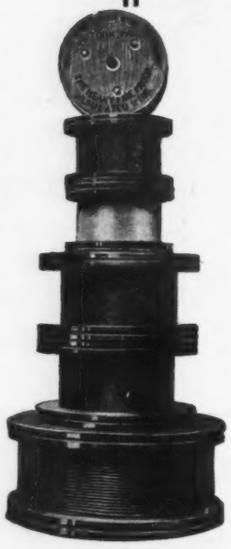

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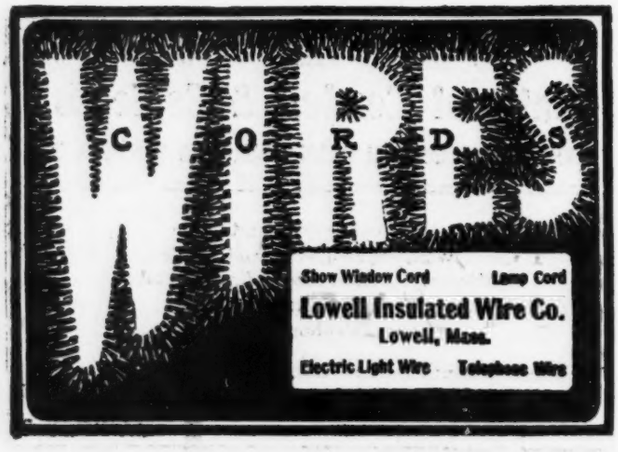

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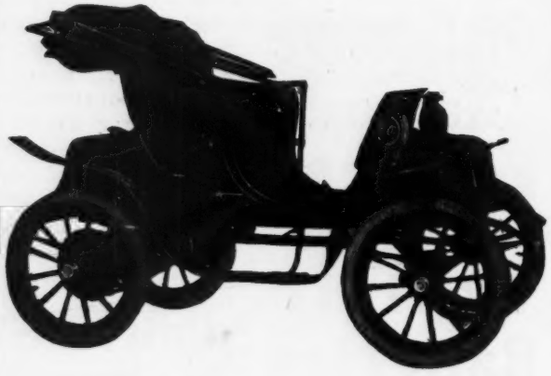

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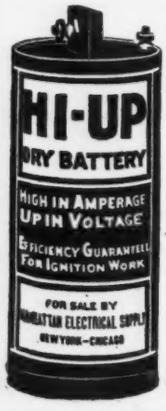

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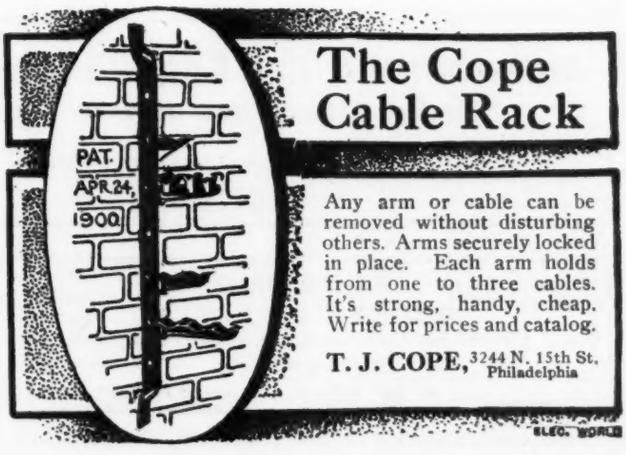

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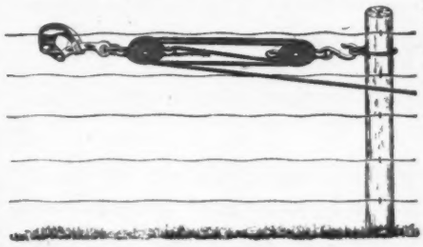

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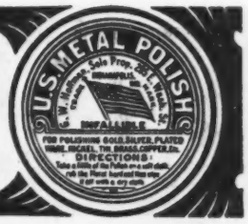

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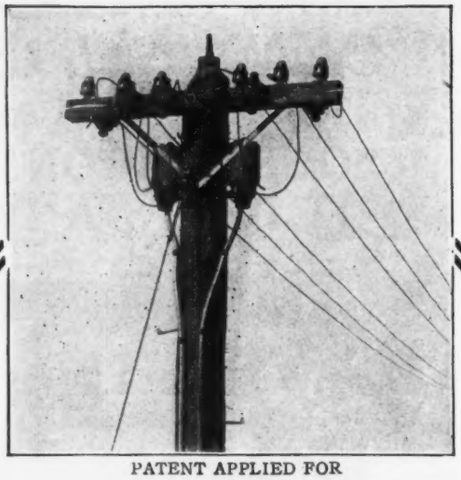

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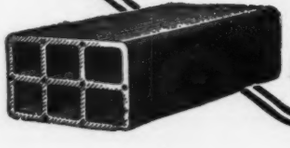

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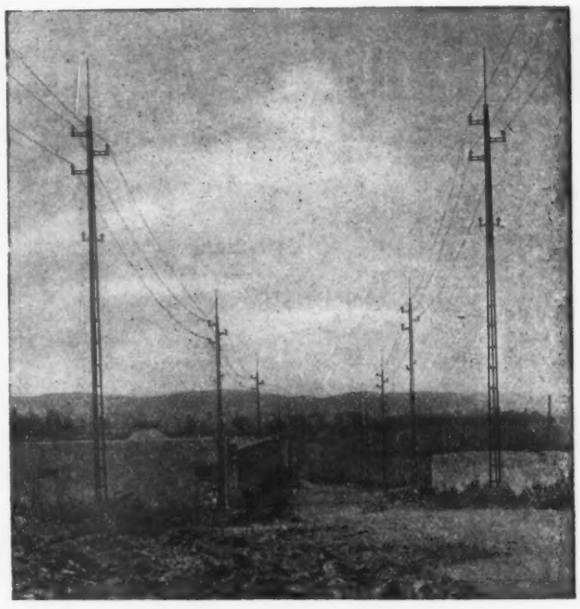

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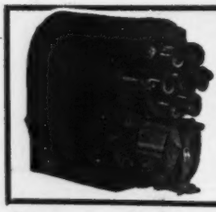

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for any insulation. Insulation equal to glass. Stands any heat. Always the same, and made exactly any shape or size. Ask for book of properties.

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HIGH EFFICIENCY INSULATORS

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they prevent creeping of moisture.

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For where strength is essential.

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For all service and under all conditions, from telephone work to

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Are in a class by themselves.

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We are ready to supply all demands for our old established lines and have many improvements about which we would like to talk to you.
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are the best transformers made. Their high efficiency, perfect design and mechanical construction, and high-class workmanship result in low operating cost and freedom from repair expense. Write to nearest agent or direct to Pittsburgh.

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This transformer represents the acme of all that is up-to-date and efficient in the transformation of electrical energy from one pressure into another.

Its design is second to none in the United States—and that means all other countries, too.

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The primary terminals are insulated as none others are, or even approach.

It runs cooler; gives better service; is better insulated; costs more to build; and is already recognized to be more of a standard in its line than any of its competitors.

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Type "S" Transformers

16 Capacities, ½ to 50 Kilowatts—50 to 140 Cycles

Primary : 1100-2200 Volts. Secondary : 110-220 and 220-440 Volts

From the largest to the smallest sizes, their performance is unexcelled.

High all-day efficiency.
Low operating temperature.
Large overload capacity.
Long Life. High insulation.

These qualities alone, account for the constantly growing demand for Westinghouse Type "S" Distributing Transformers.

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Why use up the leads? It cost time and money to replace them. Dossert connectors can be disconnected with a wrench, leaving the ends of the wires in perfect condition.

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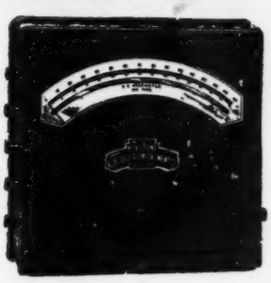

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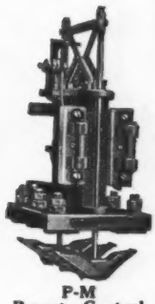
Electrical Specialties

P-M Meter Connection Block mounted with Westinghouse Type C Meter.

O K Ground Clamp.



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Then serve your customers through the

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It is absolutely impossible to get at a wire on the service side of the meter without breaking the seal, and **theft** of current without immediate detection is impossible. We have printed a circular which gives all the details. Write for a copy.

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Sangamo Meters are built as **Integrating Watt-meters** for both **Direct** and **Alternating Current,** as **Ampere-Hour Meters for Direct Current,** and in **Service** and **Switchboard** types, being suitable, therefore, for house service, for switchboard work, for street-railway cars, for electric locomotives, for use with large electroplating operations, and with storage batteries in central stations, on electric vehicles, on electric-lighted railroad cars, and in telephone exchanges.

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Complete Outfits for Photometers, for Testing Incandescent and Arc Lamps of all Kinds.

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Hand graduated—accuracy guranteed.
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Portable **Switchboard**

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High grade, dead beat, reliable and permanent.
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Accurate, Compact, Inexpensive
VOLTMETERS, AMMETERS
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Send for complete catalog.
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The Sign of Meter Quality
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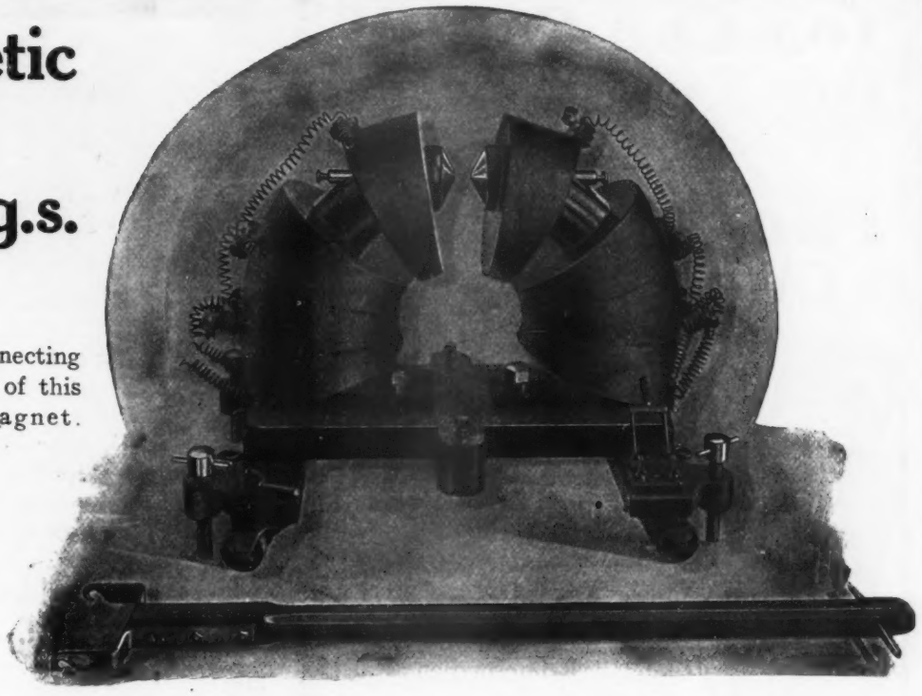
A Magnetic Field of 50,000 c.g.s. Lines

can be produced by connecting in series the eight coils of this semicircular electromagnet. The coils may readily be connected in series or in parallel, or used singly. The base is accurately planed and scraped, and is provided with levelling screws.



This apparatus is well adapted to a wide range of experiments involving magnetic fields. Write for full particulars.

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IN A CLASS BY THEMSELVES

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PHANTOM LOADS

Essential to every meter department.

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100 different sizes, adapted to all kinds or testing and laboratory work. They are light, portable and have a large number of steps. Write for circular No. 1100 which describes them in detail.

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These handsome instruments are supplied as volt, ampere, and watt meters for direct current and for alternating current; cases practically water tight. Furnished with all glass front when desired, the highly finished mechanism thus exposed presenting a very pleasing appearance. All ammeters of 100 amperes capacity and upward have separate shunts.

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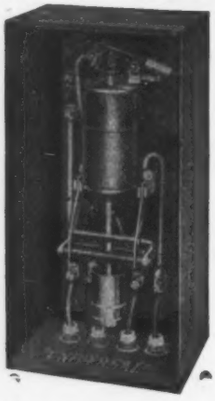
You Can Collect For Every K. W.

your customers consume if you sell your current through

The Flat Rate Controller



It measures out a definite, predetermined amount of load—no more, no less, to each consumer, who pays in advance, or every thirty days.

It enables you to entirely do away with your meter-readers and testers, and largely reduce your clerical force.

Time spent in writing for detailed information will be well spent

Do it NOW

The Universal Mfg. Co.

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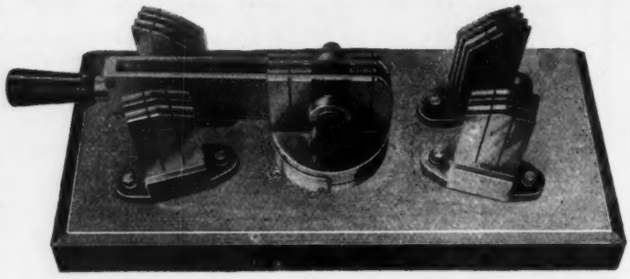

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for building all sizes of switches and switchboards for all kinds of service.
Big switches for Electric Railway, Lighting and Power Switchboards are our specialty. Send sketches or blue prints and we will estimate on your requirements.

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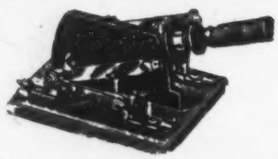
1100—Volts—2500 Hill Style D Switches



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Manufactured by

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TRUMBULL SWITCHES

The Best Seller on the market

THE TRUMBULL ELECTRIC MFG. CO.

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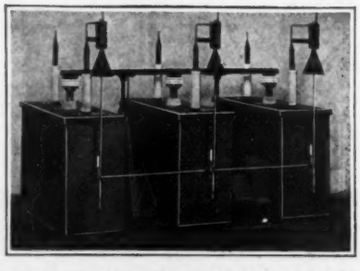
High Voltage Circuit Breakers

15,000 to 110,000 Volts

Manual or Electrical Operation

Time Limit



High Insulation

Horizontal Break

Large Quantity of Oil.

Simple Construction

Easily Accessible

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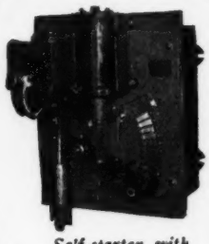
CUTLER-HAMMER

AUTOMATIC CONTROL OF ELECTRIC MOTORS

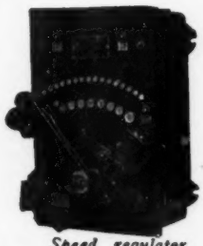


Self-starter with main line solenoid switch.

The art of controlling electric motors automatically has made great strides in recent years. By means of automatic devices certain operations, or a series of operations, can be repeated in regular cycles without requiring the presence of an attendant. Moreover, it is possible by the use of automatic apparatus to positively insure the motor against damage due to too sudden starting or stopping, abnormal current conditions, etc. We make automatic starters for pumps, fans and motor-operated machinery of all kinds. **Bulletins on request.**

Three-pole float switch.

FAN AND BLOWER REGULATORS



Speed regulator with no-voltage and overload release.

For the control of motor-driven fans and blowers we have standardized a comprehensive line of apparatus ranging from one-sixth H.P. speed regulators upward. Controllers can be furnished either for manual or for automatic operation. For the control of blowers used in connection with automatic stokers we can furnish a controller that will regulate the speed of the fan according to the boiler pressure. **Bulletins on request.**

Moisture-proof resistance for damp locations.

MACHINE TOOL CONTROLLERS

Panel type machine tool controller.

The fact that the leading motor manufacturers and machine tool manufacturers of the country have for years been the largest purchasers of Cutler-Hammer machine tool controllers would seem to indicate that this line of apparatus meets more fully than any other the various requirements of machine tool speed regulation. Our standard line of apparatus embraces controllers for every sort of motor-driven machine tool. We make a specialty of automatic starters for both alternating and direct current. **Descriptive bulletins on request.**

Drum type machine tool controller.

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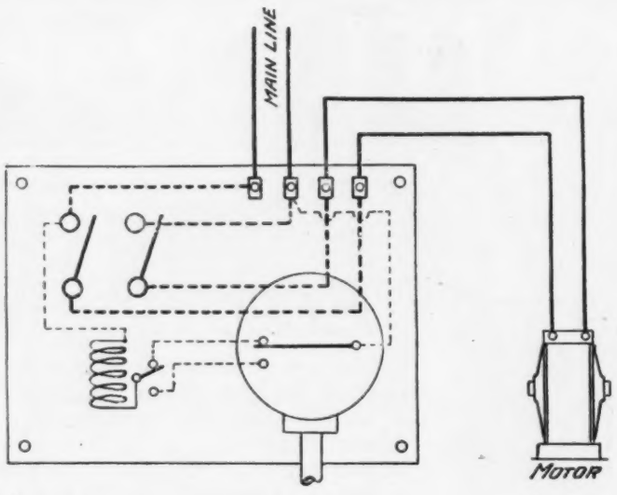
NEW YORK: Hudson Terminal (50 Church Street) CHICAGO: Monadnock Block PITTSBURG: Farmers' Bank Building
BOSTON: 176 Federal Street PHILADELPHIA: 1207 Commonwealth Trust Bldg. CLEVELAND: 1108 Schofield Bldg.
PACIFIC COAST AGENTS: Otis & Squires, 155 New Montgomery Street, SAN FRANCISCO

This Diagram Shows How Simple It Is



to wire up a Sundh Pressure Regulator for starting a small motor without the use of a starting resistance.

The double pole type of Pressure Regulator is shown, but in many cases of Direct Current and single-phase Alternating Current, a single pole type can be used. It may be also adapted for starting A. C. Motors of two or three phases, three wire, or two phases, four wire when it is permissible to open two circuits and to run the neutrals direct to the motor.

The Sundh Catalog contains detailed information. Shall we send it?

SUNDH ELECTRIC COMPANY

NEW YORK, U. S. A. 2

SACHS ENCLOSED FUSES are the perfected result of over fifteen years of "Sachs" enclosed fuse experience, embodying many features of marked superiority. They are manufactured with both old and new standard dimensions and contacts for all voltages, and in ampere capacities from ½ to 1,000 amperes, operating under excess current conditions without arc or flash. Accurately carry their rated load and operate under overload in a definite time interval. Furnished with Type A, or screw contacts, Type B, or ferrule contacts, and Type E, or knife-blade contacts. Also a variety of special old standard contacts.

Structural and operative features of decided advantage are: Tubes of high-grade and extra heavy fibre, with Protective lining. Ferrules are made extra heavy and securely fastened to tube by screws. Where ferrules are used for contact they are held to the tube by prongs cut from metal of ferrules, and not by pins with projecting heads. Knife-blade contacts have round and not sharp square edges. Fuses of large ampere capacities have multiplied fuse links. All fuse strips are joined mechanically as well as by solder to the terminal wires thus eliminating unblown open-circuited fuses. Indicator is directly operated and is large and clear, being located in the ferrule instead of under a label.

QUALITY UNSURPASSED **PRICES RIGHT**

THE SACHS FUSE

THE SACHS CO., Hartford, Conn.

New York Chicago St. Louis Toronto, Can.
Boston San Francisco New Orleans London, Eng.

SACHS ENCLOSED FUSE CUTOUTS are furnished for National Electric Code Standard Fuses as well as Type A or B Old Code Fuses. They are designed to minimise the losses due to a multiplicity of connections or contacts between the circuit and the fuse terminal. National Electric Code Standard Blocks are made in 1, 2 and 3-pole main line to 100 amperes and 1-pole up to and including 600 amperes, also single and double branch blocks, up to and including 60 amperes. Bases up to 100 amperes are of the highest grade of porcelain, and the contacts of each line or single pole are protected on each side by upright walls. Larger bases are of high-grade slate. The clips and circuit connection contacts on all blocks up to 100 amperes are of one-piece construction instead of two pieces clamped together as usually used. Lugs on blocks above 30 amperes do not project beyond the edge of the blocks.

SACHS ENCLOSED FUSE CONTACTS AND FITTINGS are furnished for use on switchboards or panel boards either Type A screw contact, Type B clip contact, or Type E knife-blade contact. The latter are made of either high-grade bronze or solid spring copper. Clips are fastened to the head of the stud by rigid mechanical fastening which is also joined by solder. Nuts of ample conductivity are provided. 1

Screw This Ground Point On A Pipe, And Drive It

down to permanent moisture. It makes a perfect earth connection. Write for Bulletin H.

LORD ELECTRIC COMPANY
213 West 40th St., New York

THE MONITOR AUTOMATIC

Motor Starters and Controllers

No Dash-Pot
No Sliding Contacts
No Voltage Magnets
No Fixed Time Element

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and simplicity—that accurately describes
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Full details in catalog. Write for it.
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Vacuum Drying and Impregnating Machines
Manufactured by
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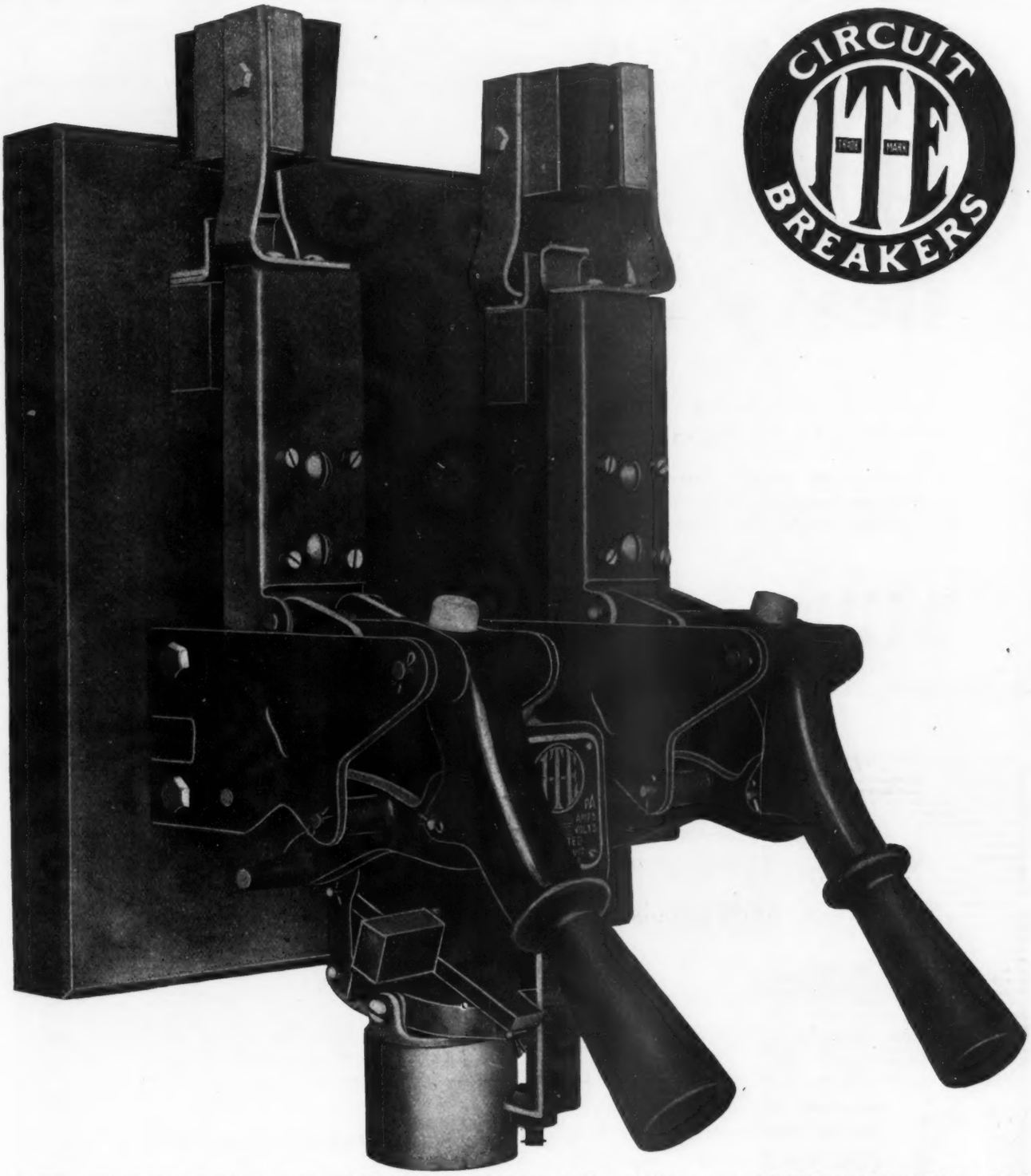

TYPE "W" DOUBLE-POLE, OVERLOAD AND "DALITE" (TIME LIMIT), INDEPENDENT OPERATING ARMS DESIGNED ESPECIALLY FOR THE PROTECTION OF INDIVIDUAL MOTORS.

A fuse is cheaper than a circuit breaker—it ought to be; but an *I-T-E Circuit Breaker* is not as expensive as it ought to be, considering the work it does. There are several circuit breakers on the market more expensive; but they cost less to buy; they are more expensive than the I-T-E because they won't last, or won't work, or both.

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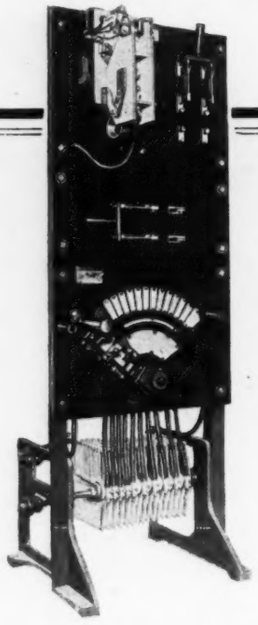

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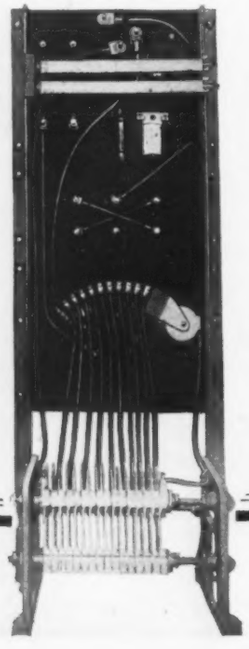
such as a hot saw or a press with a heavy fly wheel, where a considerable amount of energy must be expended in bringing the load up to working speed, use our new

Mill Type Motor Starters

They give the motor a starting current in excess of the running current, and materially reduce the starting time. Separate and different overload protection is provided for accelerating, besides overload protection for running, and no-voltage release. These starters are made in completely self-contained panels with supporting feet, and may be installed side by side, forming a continuous control board for several motors. Made in many types and sizes. Bulletin No. 361 describes them all.



Shall we send you a copy?

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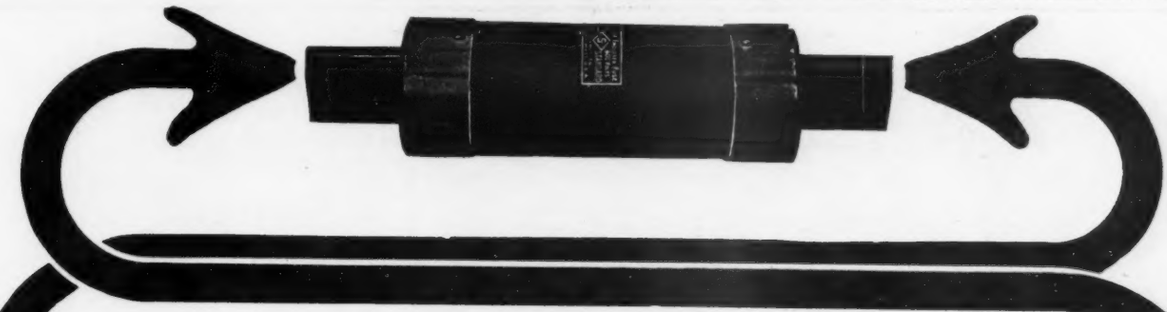

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—accuracy in current carrying capacity is rigidly insisted upon in our factory.

We were the first makers of open fuses to test our fuse wire and our experience in making accurate fuses works to your advantage.

Your jobber either has them in stock or will get them for you.

If you haven't the catalog, write for a copy to-day.

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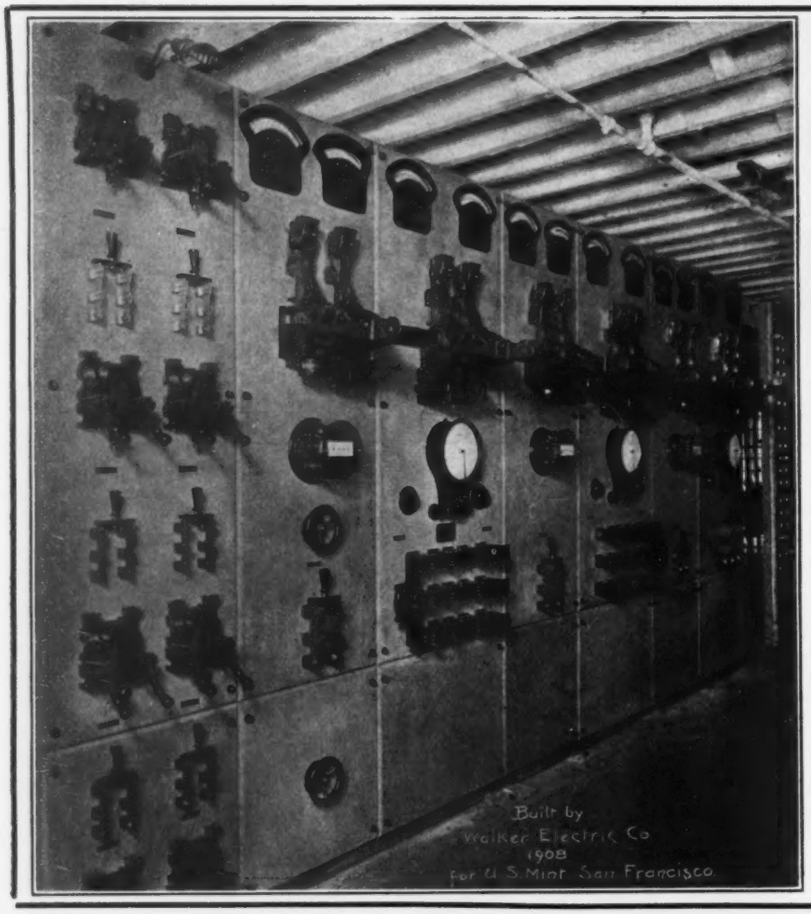

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for springs. We're experts and make good springs—all sorts. Write

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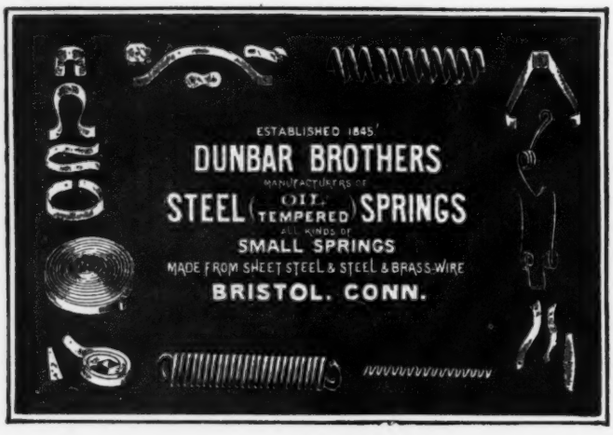

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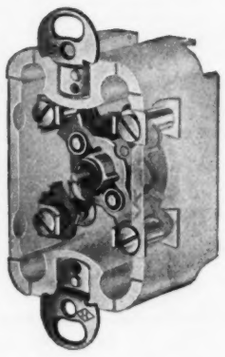

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Every detail of the "Diamond H" Rotary Flush Switches has been carefully worked out and tested. In their manufacture neither labor nor expense is spared to make them pre-eminently the best switches of their type. Every switch is carefully assembled and subjected to a rigid examination before leaving the factory. It is guaranteed to give satisfactory service wherever installed. A comparison with switches of any other make will furnish convincing evidence that "Diamond H" Switches are unequalled in durability, efficiency and general mechanical excellence.

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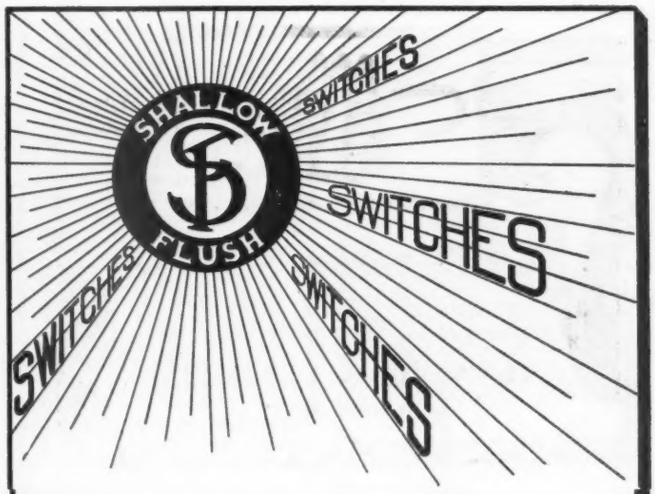

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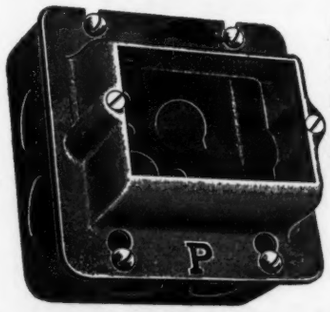

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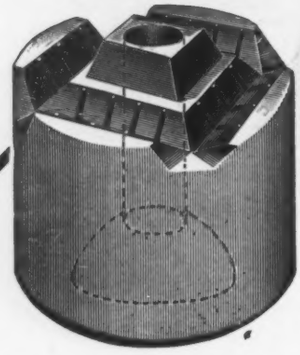

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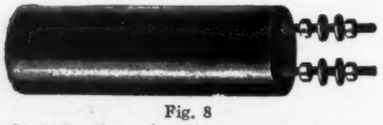

Fig. 8

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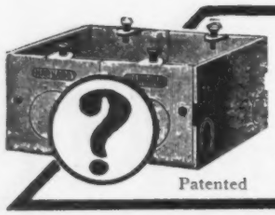

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The Doubtful Point

in many sectional switch boxes is the means provided for assembling the gangs. The one box which hooks together rigidly is the

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—and all other boxes which hook together infringe our patents, and are imitations of Harvard Boxes. Catalog describes our construction, and is gladly sent to those who ask.

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can be supplied in finishes to harmonize with any scheme of decoration.

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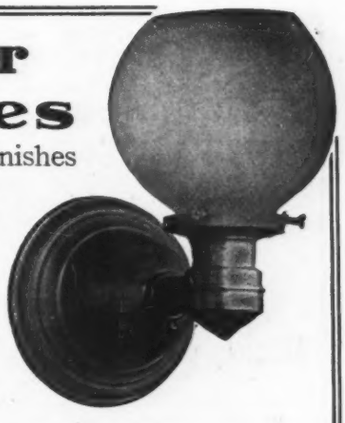
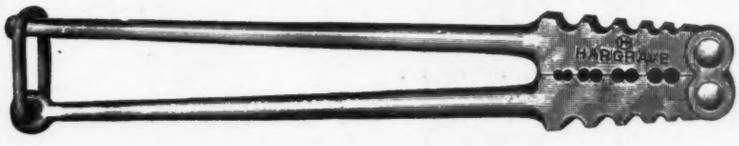


The Morreau Gas Fixture Mfg. Co.

Cleveland, Ohio



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It operates at ANY height or ANY angle.

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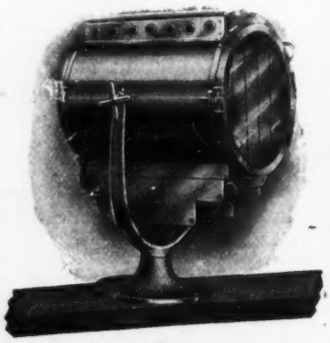

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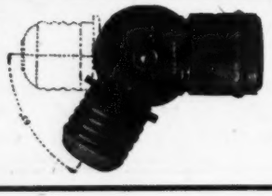

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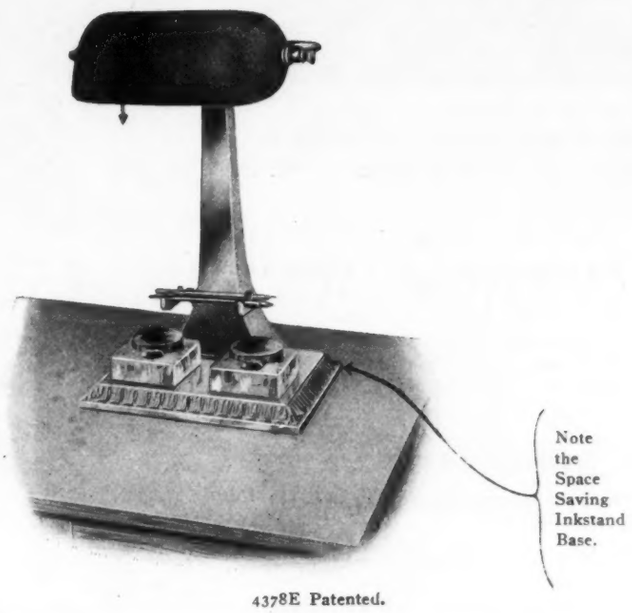

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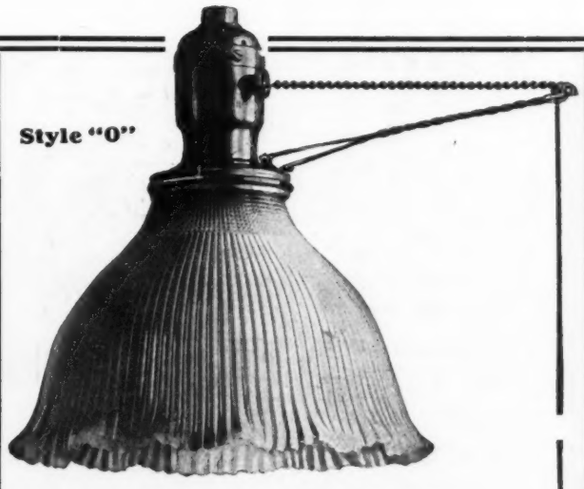

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It is perfectly rigid, and has no springs to get out of order. Minimizes vibration, and never wears out. Style "O" for small base lamps. Style "H" for large lamps.

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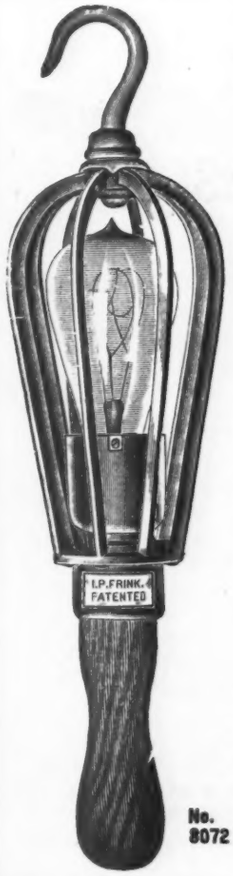

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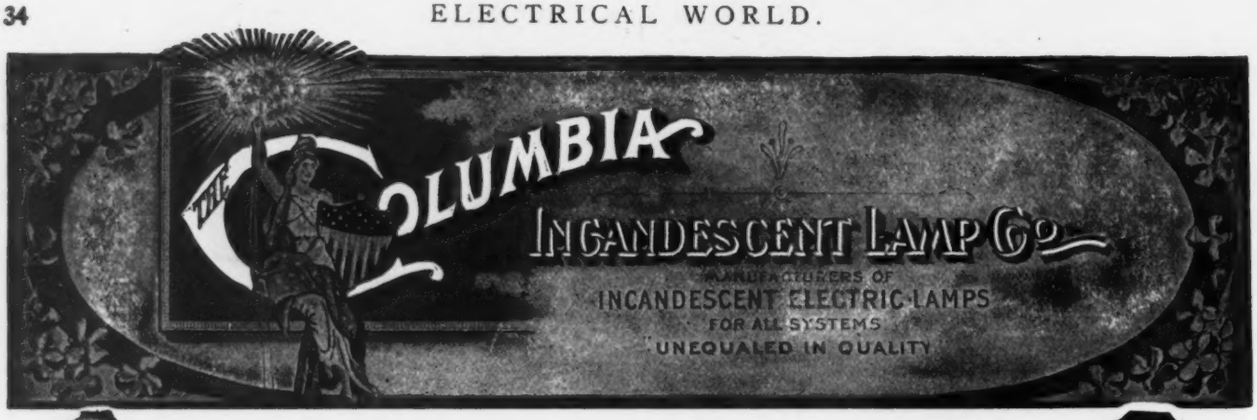

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All types and wattages (1¼ watts per C. P.)

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Write for proposition covering your yearly requirements of all types of lamps.

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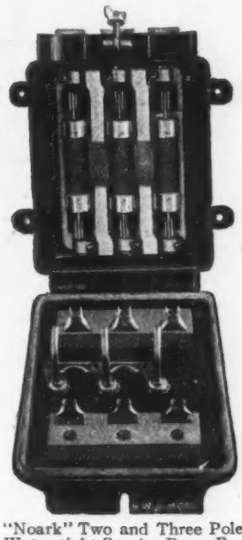
in the way of Switches and Cut-outs is a

"NOARK" Service Switch

The Underwriters' Laboratories approve it as a combination of these two devices.



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You can open the cover without disturbing the fuses, or lift out the fuses with the cover and return them accurately into position by simply closing the box. A single handle on the center of the cover controls the interconnected hooks which engage the fuses. Fuse aligning clips on the cover accurately locate the fuses even when they have been carelessly inserted in the cut-out blocks. The cable holes are provided with porcelain bushings attached by forcing lead into an aperture, the cross section of which is such that the bushing is locked rigidly in place. Various conduit fittings may also be attached to the box by means of screws furnished with it. Where a water or gas-tight joint is desired, we furnish rubber gaskets to be inserted between the planed surface of the fitting and box.

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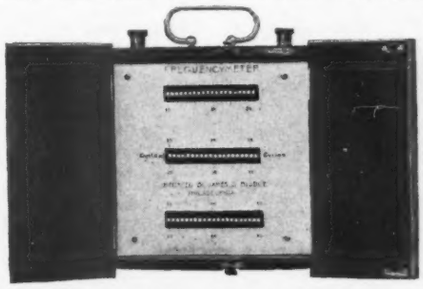

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Write for Prices. The Lippincott Glass Co., Alexandria, Ind.

LAMP EFFICIENCY

The lighting specialists whose practical experience and technical knowledge are behind the production of our Silvertip Flaming Carbons are recognized leaders in illumination engineering.

Every possible effort has been put forth to make an honest carbon of unequalled qualities.

Results, and rapid growth in orders have surpassed all our expectations and brought Silvertip Flaming carbons to the front in a very forcible and conspicuous manner.

The light from Silvertip is more powerful, has a deeper and richer color, and penetrates farther than that of any other flaming carbon.

The high quality of the ingredients and the great care exercised in manufacture have produced a standard of uniformity unapproachable.

Every possible condition that will affect service qualities has been considered by our experts in producing Silvertip — already noted for its efficiency, reliability and economy.

We invite inquiries and solicit the opportunity of co-operating with lamp operators to obtain for them a maximum lamp efficiency at a minimum cost

National Carbon Company, Cleveland, Ohio

We manufacture and can ship promptly a complete line of permanently installed vacuum cleaning machines, from 1 H. P., one sweeper, to 30 H. P., twelve sweeper outfits inclusive, and we have proved conclusively to Architects and Engineers throughout the country who have investigated that we build the most efficient, simple and successful vacuum cleaning machine on the market. Floor space, even in the basement of buildings is valuable and as we require no complicated auxiliary wet and dry separating tanks our machines require only a small fraction of the floor space necessary for piston and rotary pump vacuum cleaning outfits. For example, our 15 H. P. six sweeper turbine cleaner occupies a floor space only 31 inches square.

Kindly note that this machine has no belts, chains or gears, neither do the stationary and moving parts of the air turbine come in contact except at the bearings. This, you will appreciate, almost entirely eliminates noise and also the possibility of trouble.

Spencer Turbine Cleaners are in successful operation in buildings of all kinds, from residences to factories, and on request a list of hundreds of entirely satisfied users throughout the world will be sent to you as references. **What the user has to say is what tells the story.**

THE SPENCER TURBINE CLEANER CO.

Principal Office and Factory
HARTFORD, CONN.
AGENCIES IN ALL THE PRINCIPAL CITIES

STEINER'S FAMILY MOTOR

One Motor for all purposes.

Write for Catalogue

STEINER MFG. CO., 2000 N. 14th St., ST. LOUIS, MO.

"STEEL CLAD" and "SUPERIOR" IRONS

190 DIFFERENT ELECTRICAL HEATING DEVICES

American Electrical Heater Co.
DETROIT, U. S. A.

Largest and oldest exclusive makers in the world.

There's Money in the Del Electric Curling Iron

for the Central Station man who uses it in business getting. Write for particulars and prices.

Del Sales Company, 250 Dearborn St., Chicago.

The personal factor in selling to women

must be taken into account, otherwise the best selling campaign falls flat.

Hoover's Electric Suction Sweeper

sells readily to women because designed by men experienced in such matters.

It is the one sweeper that women will invariably use right.

Let us send you a sweeper for 10 days' free trial and see.

Big profits for Central Stations and dealers acting as agents. Write—

Hoover Suction Sweeper Co.

General Offices:
New Berlin
Ohio

HOSKINS
TRADE MARK REGISTERED

Electric

TOASTOVE

—sells readily. It is unique, attractive and serviceable—"in a hundred ways," throughout the home.

Write its maker

HOSKINS MANUFACTURING COMPANY
Electric Furnaces and Heating Appliances
467 Lawton Avenue, DETROIT

Watch for our **Announcement** in next week's Electrical World. 90

The "IMPERIAL"

A Portable Vacuum Cleaning Machine combining efficiency, practicability and economy. Can be attached to any electric light socket.

"The Only High-Grade, Efficient Machine on the Market." Guaranteed.

A Dividend Payer for Central Stations

Growing concerns and responsible parties wanted for agents. Exclusive territory given. Send for Catalogue and particulars.

PRICE $100, COMPLETE

EMPIRE VACUUM COMPANY
112 West 30th Street, New York

Pelouze "Universal" Iron

Control of Temperature Current on

The Iron of Highest Efficiency and Greatest Endurance

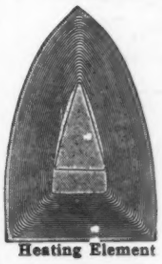
THREE SIZES
4 lbs. 6½ lbs. 9 lbs.

When Not in Use

A complete departure from old methods of construction—a utilization of latest scientific discoveries in accordance with sound engineering principles

The Electrical and Mechanical Advantages Are:

1. Highest efficiency and economy—guaranteed to do perfect work on less current.
2. Greatest endurance. Heaters guaranteed one year, but should last many years.
3. Heaters interchangeable by anyone. Heating element and contacts complete in itself.
4. No stand required simply tip iron back until it rests on handle.
5. Hot point and edges—perfect distribution of heat.
6. More weight in front, better balanced.
7. Cool top, saves current.
8. Control of temperature while ironing by a simple motion of the hand.
9. Very quick starting, ready for work in 4 minutes.



Heating Element

New 3-Heat Tailor's Goose
Just Out

Pelouze Electric Heater Co.

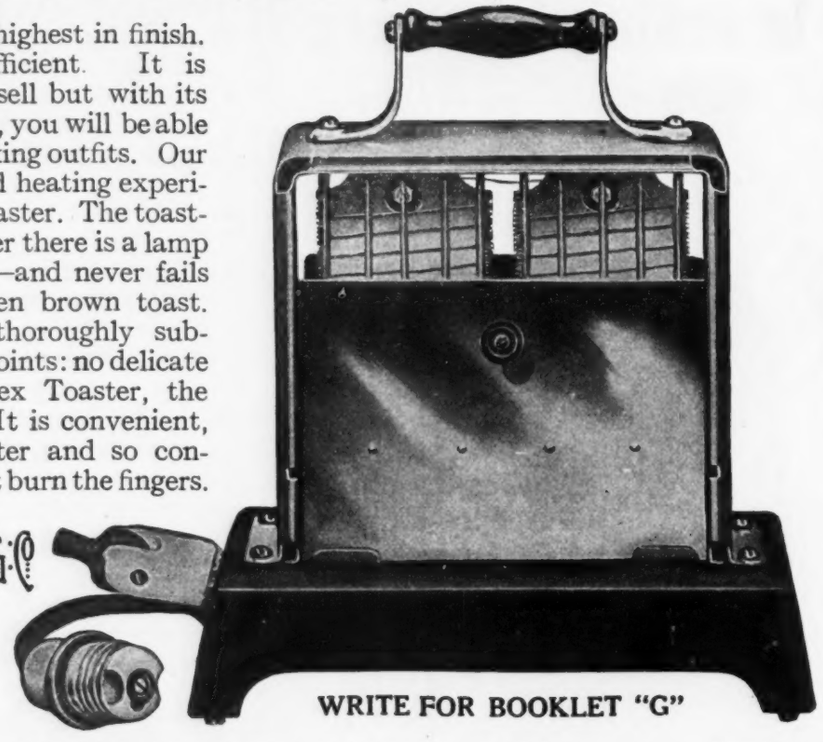
232-242 East Ohio Street
Chicago, Ill.
Send for Prices. For Sale by Leading Electrical Jobbers

Heat Distribution

THE SIMPLEX TOASTER

SIMPLEX QUALITY

New in design and highest in finish. Durable—Reliable—Efficient. It is not only very easy to sell but with its many features of merit, you will be able to install complete cooking outfits. Our "Simplex Quality" and heating experience goes with every toaster. The toaster can be used wherever there is a lamp socket—always ready—and never fails to produce crisp golden brown toast. The construction is thoroughly substantial. No soldered joints: no delicate parts. Get the Simplex Toaster, the best on the market. It is convenient, clean and rapid toaster and so constructed that it will not burn the fingers.



SIMPLEX ELECTRIC HEATING CO.

CAMBRIDGE, MASS.

Monadnock Block, Chicago
612 Howard St., San Francisco

WRITE FOR BOOKLET "G"

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At Last

we offer a battery phone which can be carried in stock for practically all systems—the

Connecticut Interchangeable

It is the most up-to-date battery phone on the market.

Write for Catalog 65-W.

Conn. Telephone & Elec. Co.
Meriden, Conn., U. S. A.

IDEAL RESISTANCE WIRE

Is doubling its output every month.
WHY?
Because it cannot be equalled for quality and price.

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ELECTRIC BELLS
ANNUNCIATORS
SPEAKING TUBES, ETC.
ELECTRIC LIGHT SUPPLIES

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EDISON BSCO PRIMARY BATTERIES

Our book about Edison BSCO Primary Batteries gives full details as to their construction, and shows just why they will give more reliable service than the batteries you are now using, no matter what your requirements are—and at a cost of maintenance far below that of any other battery made.

Write us to-day for this book.

Edison Manufacturing Co., 2 Lakeside Avenue, Orange, N. J.

Fire Risk and Insurance Are Reduced

by Vulcan Electric Soldering Appliances. For all voltages from 104 to 230. Write for details.

Vulcan Electric Heating Company 545 W. Jackson Blvd., CHICAGO

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FEDERAL ELECTRIC COMPANY

No. 752—Cluster

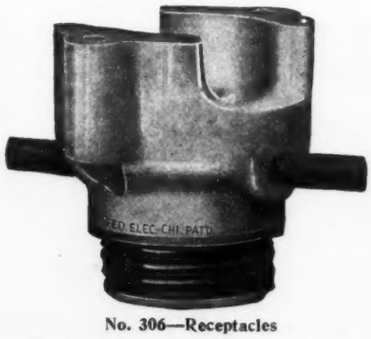
Designed to bring out every advantage of tungsten illumination and provide a neat and inexpensive fixture for store lighting. Porcelain glass reflector with sockets set in porcelain enameled steel center disk, giving perfect distribution of light. Full line of clusters described in Bulletin No. 815.

Federal Porcelain Clamp Bushings

Best vitrified porcelain, with copper clamping rings. Easily and quickly installed. Unaffected by heat, cold or moisture. Approved by Underwriters' Association.

Federal Bonding Clamps

Holds outlet box firmly at right angles to dummy or gas pipe. No threading required.



No. 306—Receptacles

An inexpensive porcelain receptacle for walls or ceiling. Waterproof and durable. Shades attached directly to receptable by clamping ring. For outdoor use, porches, corridors, etc.

Porcelain Enameled Steel Sectional Letter Electric Signs

Manufactured under Federal Patents. The most brilliant, durable and attractive signs made. Will outlast painted wood or metal signs and never lose its brilliancy. As good the third year as the first. Bulletin No. 811 sent on request.

Federal Electrical Supplies AND Specialties

Time and labor-saving devices embodying exclusive patented features found only in Federal goods.

Highest standard of quality and workmanship at reasonable prices.

New Bulletin No. 820 describing sockets, bushings, clamps, shades, etc., now on the press. Write for copy.

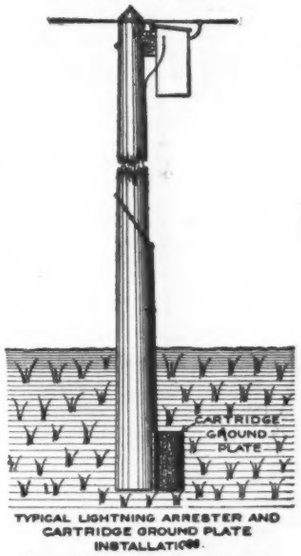
FEDERAL ELECTRIC COMPANY
LAKE AND DESPLAINES STREETS
CHICAGO

Federal Clamp Sockets

save time, labor and money.

A handsome four-light fixture for tungsten lamps. The lights are attached to cross arms by chain links, which minimize the jar and prolong the life of the tungsten lamps. Supplied in 2, 3, 4, 5 and 6-light combinations. Full line of fixtures and units for residence illumination described in Bulletin No. 815.

No. 1001—Fixture



TYPICAL LIGHTNING ARRESTER AND CARTRIDGE GROUND PLATE INSTALLATION.

Federal Cartridge Ground Plate

The illustration shows method of installing Federal ground plates. Packed in cylindrical pasteboard cartons, the cartridge is dropped into ordinary post-auger hole and quickly connected. Saves time and labor and insures a perfect ground.

Federal Metal Cabinets

Strong, galvanized boxes for switches or cut-outs. Well made and inexpensive. Standard sizes. For either indoor or outdoor use.

WE ANNOUNCE THE

KLAXONET

The KLAXONET is to the KLAXON what the snappy roadster is to the Cup racer. It embodies all the essential elements of the KLAXON in smaller size and simpler form, and at a price which will appeal to every owner of a small car!

It has the characteristic KLAXON NOTE — the sharp metallic tone that warns.

Its pitch is considerably higher than that of the KLAXON, thereby gaining penetration which largely offsets the smaller volume of sound.

It is wound like the KLAXON, for 6 volts, but it consumes only about one-third as much current. It may be worked with economy and satisfaction on 4 to 6 dry cells.

The motor, like that of the KLAXON, is thoroughly high grade in design and construction. Every detail is as carefully worked out for durability and hard service as in the larger machine.

THE PRICE IS $20

Look for the KLAXON and KLAXONET at the New York and Chicago Shows!

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Mnaufacturers
NEWARK, N. J.

THE KLAXON COMPANY
Sole Distributors for U. S. A.
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The following pages indicate a

Sales Policy

which is as unique as it is successful.

It is a policy having for its basis,

Quality

the success of which is evinced by upwards of 4,500,000

Western-Electric

"Bell" Telephones

in use throughout the country, and the constantly increasing demand for

Hawthorn

Power Apparatus and Supplies.

The Trade Marks

shown are the emblems of manufacturers whose products are

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in the Electrical field.

Each Trade Mark implies an established standard of

Quality

Each Trade Mark is your

Guarantee

of quality.

It is more than that.

These Trade Marks indicate the lines of greatest

Economy

in the development and maintenance of electrical equipment.

Grouping these manufacturing emblems—these trade marks—in this way has a special significance which must appeal to every buyer of electrical equipment and supplies.

No other jobbers cover the field so completely, either with products of established quality, or with an organization of selling and distributing houses so well equipped to serve efficiently buyers of every class.

For the Electrical Dealer, Contractor, Central Station Operator and Consumer this distinctive scheme of

Quality Stocks and Unequalled Distributing Facilities

must suggest the direction your orders should take.

Western-Electric

COMPANY

Manufacturers of the celebrated "BELL" Telephone and "HAWTHORN" Power Apparatus

These Trade Marks Imply Established Standards of Quality

HUBBELL

Hawthorn

TRADE MARK

MOTORS, GENERATORS, ARC LAMPS, FANS, IGNITION BATTERIES, ANNUNCIATORS, BELLS, SOLDERING COMPOUNDS, TRANSFORMERS

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SUPERIOR WIRING DEVICES

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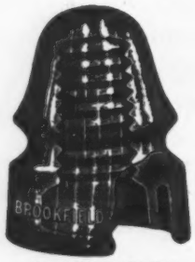
"Telephone Our Nearest House"



BROOKFIELD GLASS SPECIALTIES, INSULATORS

TRADE VICTOR

FANS, TAPE, CORD

"See the Teats on the Petticoat" HEMINGRAY GLASS INSULATORS

The Western Electric Company Has Equipment for Every Electrical Need

Complete Stocks of All These Standard Lines Are

CARRIED BY THE

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Denver
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Societe de Material Telephonique

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TUNGSTOLIER DAYLIGHT

Hawthorn

TRADE MARK

MOTORS, GENERATORS, ARC LAMPS, FANS, IGNITION BATTERIES, ANNUNCIATORS, BELLS, SOLDERING COMPOUNDS, TRANSFORMERS

PERKINS SUPERIOR WIRING DEVICES

PERKINS' ELECTRICAL SPECIALTIES

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RUBBER COVERED WIRES AND CABLES

DYNAMOS-MOTORS WESTERN ELECTRIC COMPANY CABLE-TELEPHONES-SUPPLIES

WESTON ELECTRICAL MEASURING INSTRUMENTS

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TRADE MARK

"Chloride Accumulator"

REGISTERED SEPTEMBER 11, 1894

TRADE VICTOR MARK

FANS, TAPE, CORD

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REG. U.S. PAT. OFF. & FOREIGN COUNTRIES.

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INSULATION

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These Trade Marks Imply Established Standards of Quality

BLACK CORE PARAC RUBBER WIRES

"PHILLIPS" INSULATED WIRES AND CABLES

Hawthorn

TRADE MARK

MOTORS, GENERATORS, ARC LAMPS, FANS, IGNITION BATTERIES, ANNUNCIATORS, BELLS, SOLDERING COMPOUNDS, TRANSFORMERS

WEATHER-PROOF "O.K." LINE AND HOUSE WIRES

"PHILLIPS" INSULATED WIRES AND CABLES

"CONSULT THE MAP"

1872 EDWARDS

EDWARDS & CO., INC., HOUSE GOODS

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HUGO REISINGER "ELECTRA" ARC LIGHT CARBONS

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STANDARD AND SPECIAL CROSS-ARMS

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FANS, TAPE, CORD

SUNBEAM INCANDESCENT LAMP

"Nature Smiles through Sunbeams"

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BATTERIES, ANNUNCIATORS, BELLS, SOLDERING
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"CONSULT THE MAP"

THOMAS QUALITY RELIABILITY

THOMAS PORCELAINS

DYNAMOS-MOTORS WESTERN ELECTRIC COMPANY CABLE-TELEPHONES-SUPPLIES

ELECTRIC CUTLER HAMMER CONTROLLERS

"Telephone Our Nearest House"

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SKELETON AND ENCLOSED SIGNAL BELLS

TRADE VICTOR MARK

FANS, TAPE, CORD

SIMPLEX ELECTRIC QUALITY

ELECTRICAL HEATING APPARATUS

The Western Electric Company Has Equipment For Every Electrical Need

Complete Stocks of All These Standard Lines Are

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Western-Electric

COMPANY

Manufacturers of the Celebrated "Bell" Telephones and Suppliers of All Apparatus and Equipment Used in the Construction, Operation and Maintenance of Telephone Plants and Central Stations

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WESTERN	PACIFIC
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The Electrical World
For 1910

¶ During the coming year the ELECTRICAL WORLD will be a larger and stronger paper than ever before. Its editorial staff will be increased by the addition of two new members, making a total of eleven regular members, besides several regular contributors not directly attached to the staff. Several editors will be constantly in the field studying situations and gathering information at first hand. The ELECTRICAL WORLD will thus be enabled to keep in even closer touch than in the past with every phase of electrical work.

¶ The ELECTRICAL WORLD aims to *cover currently all development* in its field. It does not specialize on certain subjects at the expense of others, but treats adequately and thoroughly every subject that is of current interest or permanent value to its readers. Developments in the industry along certain lines require special treatment from time to time, and without neglecting any of the subjects which the ELECTRICAL WORLD has covered in the past, it will, during the coming year, devote especial attention to subjects related to situations of timely importance. Among these subjects are: Gas Producer Plants, Gas Engine Plants, Oil Engine Plants, High-Tension Insulators, The Electric Vehicle, District Power Distribution, Public Service Commissions, New Illuminants, Gas and Gasoline Competition, Rate Systems, Electric Heating, Illuminating Engineering, Photometry, The Smaller Central Station, New Business Work, Street Lighting, Underground Conduit Construction.

Your Personal Subscription

¶ Even if *you* have access to the ELECTRICAL WORLD you cannot get the full benefit of its articles and "news" unless you receive *your own copy* each week. If you miss one number you may miss the one article of the year that would be most valuable to you. Your personal subscription insures your getting *all the news* of the field while it is still fresh and valuable, and it enables you to keep *your own reference file* of the paper—a constantly growing fund of vital information bearing directly on your work.

Please Send Your Subscription for 1910
AT ONCE

ELECTRICAL WORLD, 239 West 39th Street, New York

MAZDA LAMPS

For the purpose of insuring that the incandescent lamps manufactured by them, respectively, shall have the advantage of the latest discoveries and inventions in the art, wherever made, the foremost lamp companies of America have made arrangements, whereby the technical staff of the Research Laboratory of the General Electric Company in collaboration with the technical staff of the National Electric Lamp Association and others, shall regularly follow the work which is being done in the factories and laboratories of the leading foreign and American Lamp companies and shall keep constantly informed as to the progress and development in methods and processes in each, distributing the information thereby secured to the lamp manufacturing companies enjoying the benefits of this arrangement, and selecting from all known materials and processes those best fitted for each different style and type of metal filament incandescent lamp made for or by the respective American companies.

For the purpose of identifying the lamps made in accordance with the information thus obtained, the Research Laboratory has adopted as a trade-mark the word

MAZDA

and its presence on any metal filament lamp evidences that the expert knowledge and selective skill of its technical staff entered into the production of that lamp and that the best materials and processes known to it as fitted for that type of lamp have been employed in its manufacture.

General Electric Company

The Largest Manufacturer of Electrical Apparatus in the World

Principal Office: Schenectady, N. Y.

Main Lamp Sales Office: Harrison, N. J.

Sales Offices in the following Cities:

Atlanta, Ga.
Baltimore, Md.
Boston, Mass.
Buffalo, N. Y.
Butte, Mont.
Charleston, W. Va.
Charlotte, N. C.
Chicago, Ill.
Cincinnati, O.
Cleveland, O.
Columbus, O.
Denver, Colo.
Duluth, Minn.
Indianapolis, Ind.
Kansas City, Mo.
Los Angeles, Cal.
Minneapolis, Minn.
Nashville, Tenn.
New Haven, Conn.
New Orleans, La.
New York, N. Y.
Philadelphia, Pa.
Pittsburg, Pa.
Portland, Ore.
Richmond, Va.
Salt Lake City, Utah.
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St. Louis, Mo.
Seattle, Wash.
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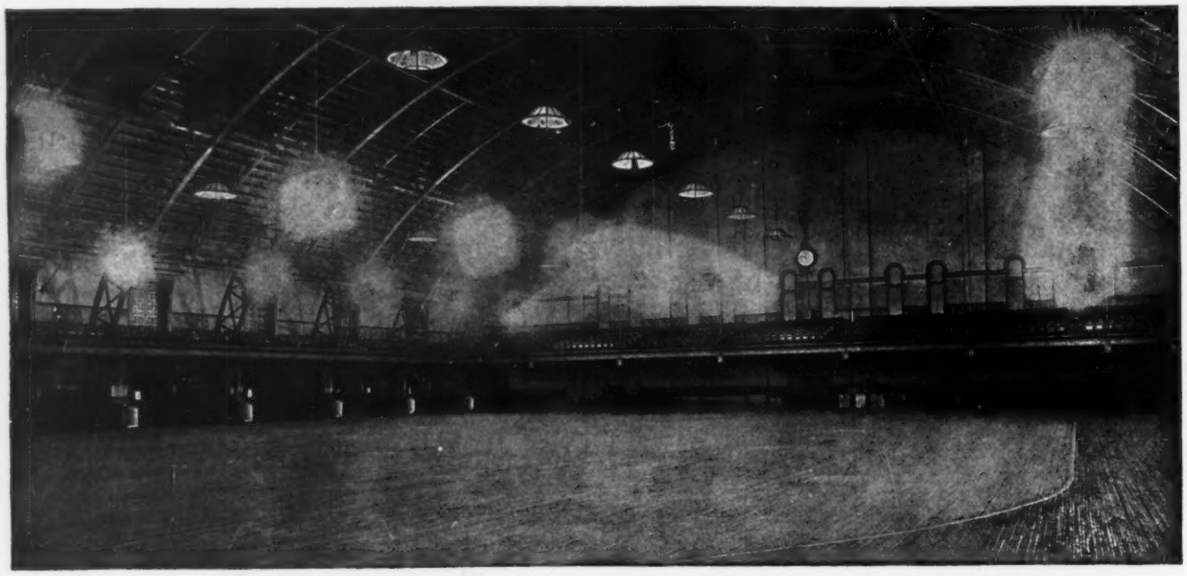
2389

General Electric Company



Interior of 22d Reg. Armory, N. Y. City. Lighted by G. I. Flame Arc Lamps.

G. I. Flame Arc Lamps

provide a superior illumination for many kinds of service

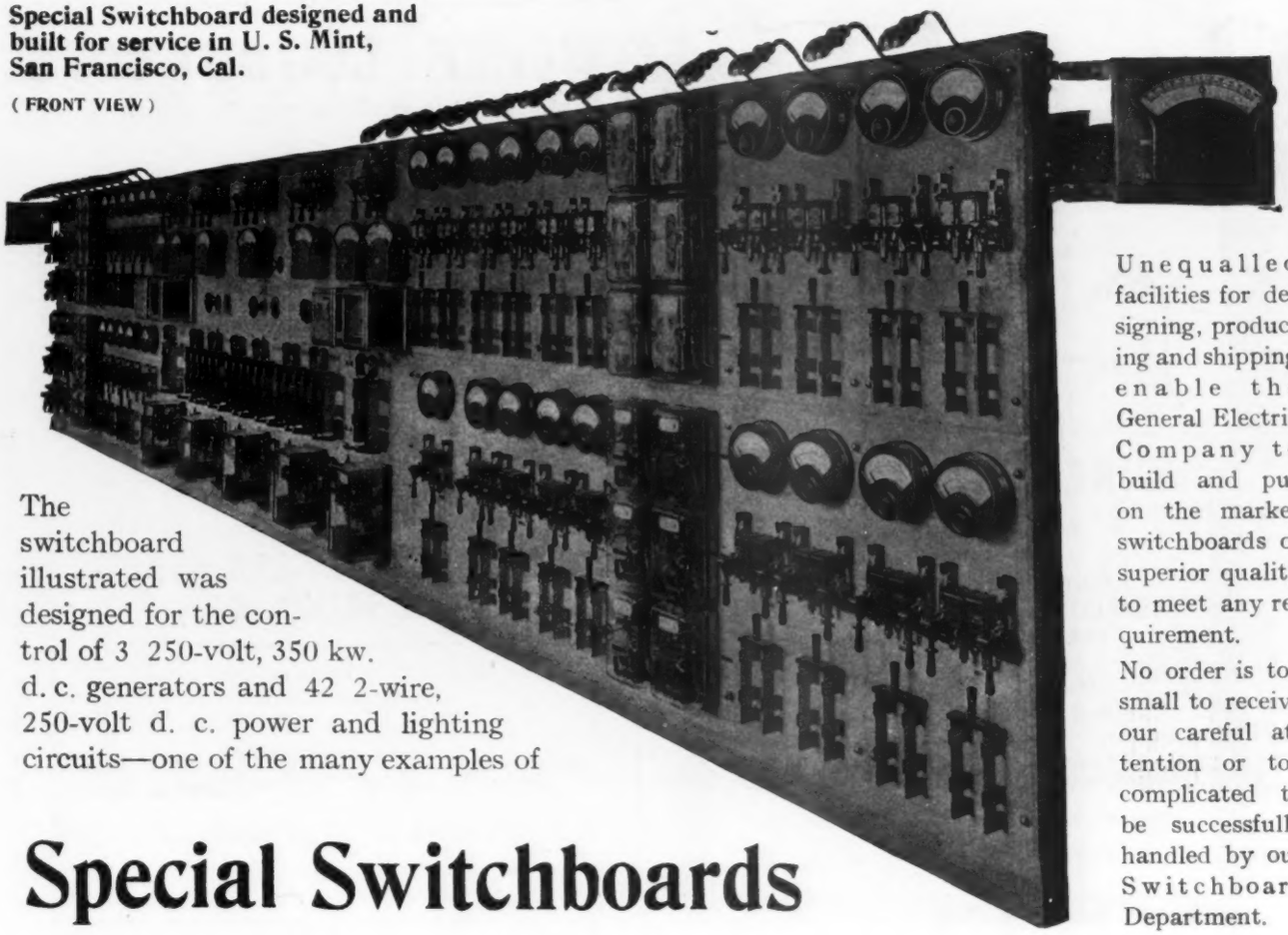
For Outdoor Use—Flame Arc Lamps have no equal as an advertising and trade drawing feature for stores. The lamp is also especially adapted for amusement parks, freight yards, train sheds, wharves and all areas requiring a large volume of light.

For Indoor Use—The illumination requirements of large interior areas are well met by the Flame Arc Lamp. A distribution characteristic which is adapted to high suspension and a penetrating color quality are distinct advantages for this class of work.

The installation of *General Electric* Flame Arc Lamps insures

Special Switchboard designed and built for service in U. S. Mint, San Francisco, Cal.

(FRONT VIEW)



The switchboard illustrated was designed for the control of 3 250-volt, 350 kw. d. c. generators and 42 2-wire, 250-volt d. c. power and lighting circuits—one of the many examples of

Special Switchboards

which the General Electric Company is prepared to furnish promptly

In the U. S. Mint Switchboard the feeders have overload, both instantaneous and time limit, low voltage and reverse current automatic protection. This unusual protection is given by G. E. Standard Circuit Breakers with auxiliary attachments.

Note the simplicity and neatness of the back of the board—a characteristic of G. E. production.

Unequalled facilities for designing, producing and shipping enable the General Electric Company to build and put on the market switchboards of superior quality to meet any requirement.

No order is too small to receive our careful attention or too complicated to be successfully handled by our Switchboard Department.

General Electric Company

New York Office:
30 Church Street

Principal Office:
Schenectady, N. Y.

Sales Offices in All Large Cities

Special Switchboard designed and built for service in U. S. Mint, San Francisco, Cal.

REAR VIEW)

KERITE

INSULATED
WIRES AND CABLES

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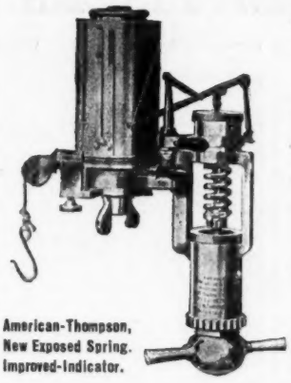

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Doubleday-Hill Elec. Co.
Eck Dynamo & Motor Co.
Electric Machinery Co.
Electro-Dynamic Co.
Emerson Electric Mfg. Co.
Fort Wayne Electric Works.
Garwood Electric Co.
General Electric Co.
Gregory Electric Co.
Guarantee Electric Co.
Helios Mfg. Co.
Kimble Electric Co.
Lincoln Electric Co.
Mechanical Appliance Co.
Richmond Electric Co.
Ridgway Dyn. & Eng. Co.
Robbins & Myers Co.
Rossmassler-Bonine Elec. Co.
Roth Bros. & Co.
Sprague Electric Co.
Steiner Mfg. Co.
Stow Mfg. Co.
Swing Electric Co.
Triumph Electric Co.
Wagner Electric Mfg. Co.
Western Electric Co.
Westinghouse Elec. & Mfg. Co.

ECONOMIZERS, FUEL.
Green Fuel Economizer Co.

ELECTRIC CLEANERS, HOUSE.
Empire Vacuum Co.
Hoover Suction Sweeper Co.
Spencer Turbine Cleaner Co.

ELECTRIC VEHICLES.
Broc Carriage & Wagon Co.
General Vehicle Co.

ELECTRICAL & EXPERIMENTAL APPARATUS.
Doubleday-Hill Elec. Co.

ELECTROMAGNETS.
Electric Controller & Mfg. Co.
Splitdorf, C. F.

ELEVATORS.
Link Belt Co.
McLauthlin Co., Geo. T.

ENGINEERS, CONSULTING.
Baehr, Wm. A.
Barstow. W. S.
Bates. Putnam A.
Baum & Co., Frank G.
Byllesby & Co., H. M.
Cravath, J. R.
Cravens, Geo. W.
Dodge & Day.
Grissinger, Elwood.
Hoar, F. Emerson.
Humphrey, C. W.
Jackson, D. C. & Wm. B.
Jalonick, Hartwell.
McMeen & Miller.
Mershon, Ralph D.
Pierce, Richardson & Neiler.
Pillsbury, Chas. L.
Reed, W. Edgar.
Sargent & Lundy.
Schofield Eng'g Co.
Smith, Kerry & Chace.
Storer, Simon B.
Thomas & Neall.
Vaill, Edw. W.
Wagner, Herbert A.
Western Eng'g & Const. Co.
Young, C. G.

ENGINEERS, CONTRACTING.
American Bridge Co.
Arnold Co.
Baum & Co., Frank G.
Central Station Eng'g Co.
Cope, T. J.
Gest, G. M.
Grissinger, Elwood.
O'Beirne, Edward J.
Pepper, Jr., David.
Sanderson & Porter.
Smith, Kerry & Chace.
Storer, Simon B.
Western Eng'g & Const. Co.
White & Co., J. G.
Young, C. G.

ENGINES, GAS & GASOLINE.
Allis-Chalmers Co.
American Engine Co.
Westinghouse Machine Co.

ENGINES, STEAM.
Allis-Chalmers Co.
American Blower Co.
American Engine Co.
Ball Engine Co.
Ball & Wood Co.
Harrisburg Fdry. & Mach. Works.
Ide & Sons, A. L.
McIntosh, Seymour & Co.
Ridgway Dynamo & Engine Co.
Skinner Engine Co.
Station Equipment Co.
Valley Iron Works.
Westinghouse Machine Co.
Wisconsin Engine Co.

EXPANSION JOINTS.
Alberger Condenser Co.

EXPERIMENTAL APPARATUS.
Buffalo Fdry & Mach. Co.
Esterline Co.

CLASSIFIED INDEX—Continued.

FAN MOTORS.
Century Electric Co.
Diehl Mfg. Co.
Doubleday-Hill Elec. Co.
Eck Dynamo & Motor Co.
Emerson Elec. Mfg. Co.
Fort Wayne Electric Works.
General Electric Co.
Peerless Electric Co.
Robbins & Myers Co.
Sprague Electric Co.
Western Electric Co.
Westinghouse Elec. & Mfg. Co.

FANS. (Exhaust and Ventilating.)
American Blower Co.
Century Electric Co.
Crocker-Wheeler Co.
Diehl Mfg. Co.
Emerson Elec. Mfg. Co.
Green Fuel Economizer Co.
Mechanical Appliance Co.
Sprague Electric Co.
Western Electric Co.

FEED WATER REGULATORS.
Liberty Mfg. Co.

FIBRE. (See Insulating Material, Fibre.)

FIBRE TUBING.
American Vul. Fibre Co.

FIELD COIL PADS.
Massachusetts Chemical Co.

FINANCIAL.
Electric Bond & Share Co.

FITTINGS.
Pratt Chuck Co.

FIXTURES. (Gas and Electric.)
Benjamin Elec. Mfg. Co.
Central Electric Co.
Frink, I. P.
Goodwin & Kintz Co.
McFaddin & Co., H. G.
Morreau Gas Fixture Mfg. Co.
Wheeler Reflector Co.

FLASHERS.
Campbell Electric Co.
Haller Sign Works, Inc.

FLEXIBLE SHAFTS.
Stow Mfg. Co.

FRICTION TAPE AND CLOTHS.
Massachusetts Chemical Co.

FUSES.
Condit Elec'l Mfg. Co.
D. & W. Fuse Co.
Johns-Manville Co., H. W.
Sachs Co.
Sears, Henry D.

GAS LIGHTING APPARATUS.
Ostrander & Co., W. R.
Splitdorf, C. F.

GAS PRODUCERS.
Hill-Hupfel Eng'g Co.

GAUGES, RECORDING.
American Steam Gauge & Valve Mfg. Co.
Bristol Co., The.
Schaeffer & Budenberg Mfg. Co.

GAUGES, STEAM.
American Steam Gauge & Valve Mfg. Co.
Schaeffer & Budenberg Mfg. Co.

GEARS.
New Process Rawhide Co.

GLASS.
Gillinder & Sons, Inc.
Phœnix Glass Co.

GLOBES, SHADES, ETC.
Gillinder & Sons, Inc.
McFaddin & Co., H. G.
Phœnix Glass Co.

GRAPHITE.
Dixon Crucible Co., Joseph.
International Acheson Graphite Co.

GRATES.
Green Eng'g Co.

GROUNDS, PLATES & POINTS.
Lord Electric Co.

GUARDS, INC. LAMP.
Frink, I. P.
Hubbell, Inc., Harvey.
Matthews & Bro., W. N.

HAIR DRYERS.
Shelton Electric Co.

HANGERS, CABLE.
Condit Elec'l Mfg. Co.
Standard Underground Cable Co.

HEATERS, FEED WATER.
Alberger Condenser Co.
Harrison Safety Boiler Works.
Platt Iron Wks. Co.

HEATING AND VENTILATING APPARATUS.
American Blower Co.
Green Fuel Economizer Co.

HEATING DEVICES, ELECTRICAL.
Del Sales Co.
General Electric Co.
Hoskins Mfg. Co.
Johns-Manville Co., H. W.
Pelouze Electric Heater Co.
Simplex Electric Heating Co.
Vulcan Electric Heating Co.

HEATING, STEAM.
American District Steam Co.

HIGH SPEED DRILLS.
Cleveland Twist Drill Co.

HOISTS, ELECTRICAL AND STEAM.
Allis-Chalmers Co.
Maris Bros.
Sprague Electric Co.

HOISTS, MAGNETIC.
Electric Controller & Mfg. Co.

HORNS, ELECTRIC.
Klaxon Co.

HOUSE CLEANERS, ELECTRIC.
Empire Vacuum Co.
Hoover Suction Sweeper Co.
Spencer Turbine Cleaner Co.

HYDRAULIC MACHINERY.
Pelton Water Wheel Co.

INDICATORS, SPEED.
Roller-Smith Co.
Schaeffer & Budenberg Mfg. Co.

INSTRUMENTS, ELECTRICAL.
Atwater-Kent Mfg. Co.
Biddle, J. G.
Bristol Co.
Connecticut Telep. & Elec. Co.
Dongan Elec. Mfg. Co.
Duncan Elec. & Mfg. Co.
Eldredge Elec. & Mfg. Co.
Esterline Co.
Fort Wayne Electric Works.
General Electric Co.
Hoyt Elec'l Inst. Works.
Johns-Manville Co., H. W.
Keystone Elec. Instrument Co.
Kunsch & Jaeger, G.m.b.H.
Leeds & Northrup.
Pignolet, Louis M.
Queen & Co., Inc.
Roller-Smith Co.
Sangamo Electric Co.
Siemens & Halske, A. G.
Taunton-New Bedford Copper Co.
Wagner Elec. Mfg. Co.
Westinghouse Electric & Mfg. Co.

INSULATING CEMENT.
Massachusetts Chemical Co.

INSULATING MACHINERY.
American Ins. Mach'y Co.
Buffalo Fdry. & Mach. Co.
New England Butt Co.

INSULATING MATERIAL.
China and Porcelain.
Brunt Porcelain Co., G. F.
Colonial Sign & Ins. Co.
Hartford Faience Co.
Imperial Porcelain Works.
Locke Insulator Mfg. Co.
Ohio Brass Co.
Pittsburgh High Voltage Ins. Co.
Star Porcelain Co.
Compounds, Paints and Varnishes.
Electric Cable Co.
Massachusetts Chemical Co.
National Insulator Co.
Ohio Brass Co.
Standard Asphalt & Rubber Co.
Standard Paint Co.
Standard Varnish Works.
Sterling Varnish Co.
Composition, Cloth and Paper.
Anderson Mfg. Co., A. & J. M.
Johns-Manville Co., H. W.
Massachusetts Chemical Co.
Munsell & Co., Eugene.
Fibre.
American Vul. Fibre Co.
Diamond State Fibre Co.
Lava.
Steward Mfg. Co., D. M.
Mica.
Munsell & Co., Eugene.
Silk.
Ryle & Co., Wm.
Staples.
Blake Signal & Mfg. Co.
Goldmark, James.
Tape.
American Electrical Works.
Johns-Manville Co., H. W.
Massachusetts Chemical Co.
New York Insulated Wire Co.
Okonite Co.
Standard Underground Cable Co.

INSULATOR CLAMPS.
Clark Electric & Mfg. Co.

INSULATORS, CHINA, PORCELAIN AND COMPOSITION.
Anderson Mfg. Co., A. & J. M.
Brunt Porcelain Co., G. F.
Central Electric Co.
Clark Elec. & Mfg. Co.
Colonial Sign & Ins. Co.
General Electric Co.
Imperial Porcelain Works.
Johns-Manville Co., H. W.
Locke Insulator Mfg. Co.
Ohio Brass Co.
Pittsburgh High Voltage Ins. Co.
Sears, Henry D.
Star Porcelain Co.
Western Electric Co.

INSULATORS, GLASS.
Brookfield Glass Co.
Hemingray Glass Co.
Locke Insulator Mfg. Co.
Ohio Brass Co.

JOINTS, SOLDERLESS.
Dossert & Co., Inc.

LAMP BASES, INCANDESCENT.
Providence Gas Burner Co.

LAMP CHANGERS OR REPLACERS.
Matthews & Bro., W. N.

LAMP-MAKING MACHINERY.
Dwyer Machine Co.

LAMPS, ARC.
Adams-Bagnall Elec. Co.
American Arc Lamp Co.
Anderson Mfg. Co., A. & J. M.
Excello Arc Lamp Co.
Fort Wayne Electric Works.
General Electric Co.
Kiewert Co., Chas. L.
Queen & Co., Inc.
Stuart-Howland Co.
Sunray Elec. Lamp Mfg. Co.
Western Electric Co.
Westinghouse Elec. & Mfg. Co.

LAMPS, DESK.
McFaddin & Co., H. G.

LAMPS, FLAMING ARC.
American Arc Lamp Co.
Excello Arc Lamp Co.
German-American Elec. Co.
Helios Mfg. Co.
Kiewert Co., Chas. L.
Stave Electrical Co.
Western Electric Co.
Westinghouse Electric & Mfg. Co.

LAMPS, INCANDESCENT.
Boston Inc. Lamp Co.
Bryan-Marsh Co.
Central Electric Co.
Dwyer Machine Co.
Economical Elec. Lamp Co.
Electrical Acessaries Co.
General Electric Co.
Heany Lamp Co.
Stuart-Howland Co.
Western Electric Co.
Westinghouse Electric & Mfg. Co.
Westinghouse Machine Co.

LAMPS, MINIATURE.
General Electric Co.

LAMPS, TURNDOWN.
Economical Elec. Lamp Co.

LAMPS, VACUUM TUBE.
Moore Electrical Co.

LAVA. (See Insulating Material, Lava.)

LIGHTING COMPANIES.
Commonwealth Edison Co.

LIGHTNING ARRESTERS.
General Electric Co.
Lord Electric Co.
Westinghouse Electric & Mfg. Co.

LINE MATERIAL.
Anderson Mfg. Co., A. & J. M.
Clark Electric & Mfg. Co.
G. & W. Elec. Spec. Co.
Johns-Manville Co., H. W.
Ohio Brass Co.
Western Electric Co.

LOADING DEVICES.
Blakeslee, H. J.

LUBRICANTS.
Dearborn Drug & Chemical Works.
Dixon Crucible Co., Jos.
International Acheson Graphite Co.
Kellogg Co., E. H.

LUMBER.
Wyckoff Pipe & Creosoting Co.

MAGNET WIRE.
Belden Mfg. Co.
Benedict & Burnham Mfg. Co.
D. & W. Fuse Co.
Massachusetts Elec. & Mfg. Co.
Riege, Archer C.
Standard Underground Cable Co.
Stuart-Howland Co.
Western Electric Co.

MECHANICAL DRAFT.
American Blower Co.
Green Fuel Economizer Co.

MECHANICAL STOKERS.
Green Engineering Co.
Westinghouse Machine Co.

MEDICAL APPARATUS.
Manhattan Elec'l Supply Co.
Pignolet, Louis M.
Splitdorf, C. F.

METALS.
American Platinum Works.
Baker & Co., Inc.
Phosphor-Bronze Smelting Co.
St. Louis Smelting & Refining Co.

METAL POLISH.
Hoffman, George W.

METER AND SERVICE BOX.
Ricker Mfg. Co.

METER CONNECTION BLOCKS.
Price-McKinlock Co.

MICA. (See Insulating Material.)

MINING MACHINERY.
Allis-Chalmers Co.
Crocker-Wheeler Co.
General Electric Co.

MODEL MAKERS.
Esterline Co.

MOTORS. (See Dynamos and Motors.)

NIPPERS AND PLIERS.
Cincinnati Tool Co.

OIL, CYLINDER.
Dearborn Drug & Chemical Wks.
Kellogg Co., E. H.

OIL FILTERS.
Liberty Mfg. Co.

OIL FUSE BOXES, A. C.
Ricker Mfg. Co.

OIL PUMPS.
Ludlow Valve Mfg. Co.

OIL SEPARATORS.
Liberty Mfg. Co.

PACKING.
Jenkins Bros.
Johns-Manville Co., H. W.
Peerless Rubber Mfg. Co.

PANEL BOARDS.
Trumbull Elec. Manufacturing Co.
Western Electric Co.

PATENT ATTORNEYS.
Stevens & Co., Milo B.
Vaill, Edw. W.

PHOSPHOR BRONZE.
Phosphor Bronze Smelting Co.

PHOTOMETERS.
Dwyer Machine Co.

PHOTOMETER STANDARDS.
Electrical Testing Laboratories.

PINIONS, RAWHIDE.
New Process Rawhide Co.

PIPE DIPS.
Standard Asphalt & Rubber Co.

PIPE AND BOILER COVERINGS.
Johns-Manville Co., H. W.

PLATINUM.
American Platinum Works.
Baker & Co., Inc.
Roessler & Hasslacher Chemical Co.

PLUGS.
Condit Electrical Mfg. Co.
Hubbell, Inc., Harvey.
Paiste Co., H. T.
Sears, Henry D.

POLES, ARC LAMP.
Mott Iron Works, J. L.

POLES, BRACKETS, PINS, ETC.
Humbird Lumber Co.
Sand Point Lumber & Pole Co., Ltd.
Stuart-Howland Co.
Western Electric Co.
Worcester Co., C. H.
Wyckoff Pipe & Creosoting Co.

POLES, STEEL.
Franklin Steel Co.

PORCELAIN. (See Insulating Material, China and Porcelain.)

POTENTIOMETERS.
Leeds & Northrup Co.

CLASSIFIED INDEX—Continued.

POTHEADS.
Colonial Sign & Ins. Co.
G. & W. Elec. Spec. Co.

POWER TRANSMISSION MACHINERY.
Link-Belt Co.

PRODUCERS, GAS.
Hill-Hupfel Eng'g Co.

PULLEYS.
Bond Co., Chas.
Rockwood Mfg. Co.

PUMPS, CENTRIFUGAL.
Alberger Pump Co.
Platt Iron Wks. Co.

PUMPS, ELECTRIC.
Fort Wayne Eng'g & Mfg. Co.
Sanitary Pump Co.

PUMPS, STEAM.
Alberger Condenser Co.
Alberger Pump Co.
Deming Co.
Goulds Mfg. Co.

PUMPS, VACUUM.
Alberger Condenser Co.

PURIFIERS, FEED WATER.
Harrison Safety Boiler Works.

PUSH BUTTONS.
Manhattan Electrical Supply Co.

RAIL BONDS.
Clark Electric & Mfg. Co.
Condit Electrical Mfg. Co.
Lord Electric Co.
Roebling's Sons Co., J. A.

REAMERS, ADJUSTABLE.
Cleveland Twist Drill Co.

REDUCING WHEEL INDICATORS.
American Steam Gauge & Valve Mfg. Co.

RECEPTACLES.
Benjamin Electric Mfg. Co.
General Electric Co.
Paiste Co., H. T.
Sears, Henry D.

RECTIFIERS.
General Electric Co.

REFLECTORS.
Frink, I. P.
Goodwin & Kintz.

REPAIRING.
Commonwealth Edison Co.
Guarantee Electric Co.

RESISTANCE UNITS.
Cutler-Hammer Mfg. Co.
Di-el-ite Mfg. Co.
Simplex Electric Heating Co.
Ward Leonard Electric Co.

RESISTANCE WIRE.
Belden Mfg. Co.
Driver-Harris Wire Co.
Electrical Alloy Co.
Prosser & Son, Thos.

RHEOSTATS.
Crocker-Wheeler Co.
Cutler-Hammer Mfg. Co.
Electric Controller & Mfg. Co.
General Electric Co.
Monitor Sales Dept.
Simplex Electric Heating Co.
Sundh Electric Co.
Universal Elec. Stage Ltg. Co.
Ward Leonard Electric Co.

ROPE PRESERVATIVE.
Cling Surface Mfg. Co.

ROSETTES.
Hart Mfg. Co.
Paiste Co., H. T.
Sears, Henry D.
Trumbull Electric Mfg. Co.

SAL AMMONIAC.
Roessler & Hasslacher Chem. Co.

SECOND-HAND APPARATUS.
Duzets & Son.
Gregory Electric Co.
Guarantee Electric Co.
Jordan Bros.
MacGovern, Archer & Co.
Partridge, Arthur S.
Power Equipment Co.
Richter, Eugene L., Electric Co.
Rossiter, MacGovern & Co.
Sachsenmaier, George.
Station Equipment Co.
Thompson, Jr., Jos. H.
Wickes Bros.

SEPARATORS (Oil and Steam).
Harrison Safety Boiler Works.

SHADE HOLDERS.
Hubbell, Inc., Harvey.

SHADES.
Frink, I. P.
Gillinder & Sons, Inc.
Hubbell, Inc., Harvey.
McFaddin & Co., H. G.
Phœnix Glass Co.

SHEET METAL.
American Sheet & Tin Plate Co.

SIGNS.
Frink, I. P.

SIGNS, ELECTRIC.
Colonial Sign & Ins. Co.
Haller Sign Works, Inc.
Universal Elec. Stage Ltg. Co.

SIGN LETTERS.
Colonial Sign & Ins. Co.
Haller Sign Works, Inc.

SLEEVING, BRAIDED.
Belden Mfg. Co.
Roller-Smith Co.

SOCKETS.
Benjamin Electric Mfg. Co.
Cleveland Twist Drill Co.
General Electric Co.
Hubbell, Inc., Harvey.
Paiste Co., H. T.
Sears, Henry D.

SOCKETS, TURN-DOWN.
Di-el-ite Mfg. Co.

SOLDER.
Belden Mfg. Co.

SOLDERING FLUX.
Blake Signal & Mfg. Co.
Condit Electrical Mfg. Co.

SOLDERING IRONS.
Simplex Electric Heating Co.
Vulcan Electric Heating Co.

SOLENOIDS.
Cutler-Hammer Mfg. Co.
Ward Leonard Electric Co.

SPLICING COMPOUND.
Massachusetts Chemical Co.

SPRINGS.
Barnes Co., Wallace.

STAGE-LIGHTING APPARATUS.
Condit Electrical Mfg. Co.
Frink, I. P.
Johns-Manville Co., H. W.
Universal Elec. Stage Ltg. Co.

STAPLES. (See Insulating Material, Staples.)

STEAM SEPARATORS.
Liberty Mfg. Co.

STEEL.
American Bridge Co.

STOKERS.
Green Eng'g Co.

STOVES, ELECTRIC.
Hoskins Mfg. Co.

STRAINERS.
Liberty Mfg. Co.

SUPPLIES. (Electric Railway.)
Anderson Mfg. Co., A. & J. M.
Johns-Manville Co., H. W.
Ohio Brass Co.
Western Electric Co.
Westinghouse Machine Co.

SUPPLIES. (General Electrical).
Central Electric Co.
Doubleday-Hill Elec. Co.
Guarantee Electric Co.
Manhattan Electrical Supply Co.
Montgomery & Co.
Ostrander & Co., W. R.
Stuart-Howland Co.
Western Electric Co.
Wetmore Savage Co.

SUPPLIES, TELEPHONE.
Western Electric Co.

SWITCHBOARD MATS.
Massachusetts Chemical Co.

SWITCHBOARDS.
Anderson Mfg. Co., A. & J. M.
Central Electric Co.
Condit Electrical Mfg. Co.
General Electric Co.
Helios Mfg. Co.
Roller-Smith Co.
Taunton-New Bedford Copper Co.
Trumbull Electric Mfg. Co.
Wagner Electric Mfg. Co.
Walker Co.
Western Electric Co.

SWITCHBOARDS, TELEPHONE.
Western Electric Co.

SWITCHBOARD SUPPLIES.
Condit Electrical Mfg. Co.
Roller-Smith Co.

SWITCHES.
Kelman Electric & Mfg. Co.
Taunton-New Bedford Copper Co.
Westinghouse Electric & Mfg. Co.

SWITCHES, KNIFE.
Anderson Mfg. Co., A. & J. M.
Condit Electrical Mfg. Co.
Cutter Co.
Taunton-New Bedford Copper Co.
Trumbull Electric Mfg. Co.
Western Electric Co.

SWITCHES, OIL.
Condit Electrical Mfg. Co.
General Electric Co.
High Tension Elec'l Spec. Co.

SWITCHES, SNAP.
General Electric Co.
Hart Mfg. Co.

SWITCHES, TIME.
Campbell Electric Co.

TABLET BOARDS.
Bossert Elec. Constr. Co.
Pratt Chuck Co.

TACHOMETERS.
Queen & Co., Inc.
Roller-Smith Co.
Schaeffer & Budenberg Mfg. Co.

TAPS AND DIES.
Carpenter Tap & Die Co., J. M.
Cleveland Twist Drill Co.

TERMINAL BOXES.
Pratt Chuck Co.

TELEPHONES.
Connecticut Telep. & Electric Co.
Manhattan Electrical Supply Co.
Stuart-Howland Co.
Western Electric Co.

TESTING APPARATUS.
Esterline Co.
Leeds & Northrup Co.
Queen & Co., Inc.
Roller-Smith Co.

TESTING, ELECTRICAL.
Electrical Testing Laboratories.

TESTING LABORATORIES.
Electrical Testing Laboratories.

THEATRE DIMMERS.
Cutler-Hammer Mfg. Co.
Simplex Electric Heating Co.
Universal Elec. Stage Ltg. Co.
Ward Leonard Electric Co.

THERMOMETERS.
Leeds & Northrup Co.
Queen & Co Inc.
Schaeffer & Budenburg Mfg. Co.

TOOL HOLDERS.
Cleveland Twist Drill Co.

TOOLS, CONSTRUCTION.
Cincinnati Tool Co.
Klein & Sons, Mathias.
Montgomery & Co.

TOOLS, ELECTRIC.
Electro-Magnetic Tool Co.

TOOLS, LINEMEN'S.
Cincinnati Tool Co.
Klein & Sons, Mathias.

TRANSFORMERS.
Allis-Chalmers Co.
American Transformer Co.
Campbell Electric Co.
Central Electric Co.
Crocker-Wheeler Co.
Duncan Electric Mfg. Co.
Enterprise Electric Mfg. Co.
Esterline Co.
Fort Wayne Electric Works.
General Electric Co.
Habirshaw Wire Co.
Kuhlman Electric Co.
Moloney Electric Co.
Packard Electric Co.
Pittsburgh Transformer Co.
Vindex Electric Co.
Wagner Electric Mfg. Co.
Western Electric Co.
Westinghouse Electric & Mfg. Co.

TRANSFORMERS, BELL RINGING.
Campbell Electric Co.
Vindex Electric Co.

TROLLEY RETRIEVERS.
Lord Electric Co.

TROLLEY WHEELS.
Doubleday-Hill Electric Co.

TRUCKS, STORAGE BATTERY AUTO.
Westinghouse Machine Co.

TUBE CLEANERS.
Liberty Mfg. Co.

TURBINES, STEAM.
Allis-Chalmers Co.
Ball & Wood Co.
General Electric Co.
Western Electric Co.
Westinghouse Machine Co.

TWIST DRILLS.
Cleveland Twist Drill Co.

VACUUM CLEANERS.
Spencer Turbine Cleaner Co.

VACUUM DRYING AND IMPREGNATING APPARATUS.
Buffalo Fdry. & Mach. Co.
Devine Co., J. P.

VALVES.
American Steam Gauge & Valve Mfg. Co.
Liberty Mfg. Co.

VALVES, CYLINDER RELIEF.
American Steam Gauge & Valve Mfg. Co.
Jenkins Bros.
Ludlow Valve Mfg. Co.

VALVES, POP SAFETY.
American Steam Gauge & Valve Mfg. Co.

VEHICLES, ELECTRIC.
Broc Carriage & Wagon Co.
General Vehicle Co.

VIBRATORS.
Shelton Electric Co.

WASHING MACHINES, ELECTRIC.
Steiner Mfg. Co.

WATERPROOFING.
Standard Asphalt & Rubber Co.

WATER PURIFYING SYSTEM.
Harrison Safety Boiler Works.

WATER WHEELS AND TURBINES.
Allis-Chalmers Co.
Dayton Globe Iron Works.
Leffel & Co., James.
Pelton Water Wheel Co.
Smith Co., S. Morgan.
Trump Mfg. Co.

WATER WHEEL GOVERNORS.
Lombard Governor Co.
Ludlow Valve Mfg. Co.
Woodward Governor Co.

WELDED FLANGES.
Ball & Wood Co.

WINDING MACHINERY.
American Ins. Machy. Co.
New England Butt Co.

WIRELESS TELEGRAPH.
Kunsch & Jaeger, G.m.b.H.

WIRE JOINTS.
Harvard Electric Co.

WIRE MEASURING MACHINES.
Waldman, John J.

WIRES, RESISTANCE.
Belden Mfg. Co.
Driver-Harris Wire Co.
Electrical Alloy Co.
Prosser & Sons, Thos.

WIRES AND CABLES.
American Electrical Works.
American Steel & Wire Co.
Atlantic Ins. Wire & Cable Co.
Bay State Ins. Wire & Cable Co.
Belden Mfg. Co.
Benedict & Burnham Mfg. Co.
Bridgeport Brass Co.
Central Electric Co.
Chicago Ins. Wire Co.
D. & W. Fuse Co.
Detroit Ins. Wire Co.
Diamond Rubber Co.
Driver-Harris Wire Co.
Electric Cable Co.
Excelsior Ins. Wire Co.
General Electric Co.
Heany Fireproof Wire Co.
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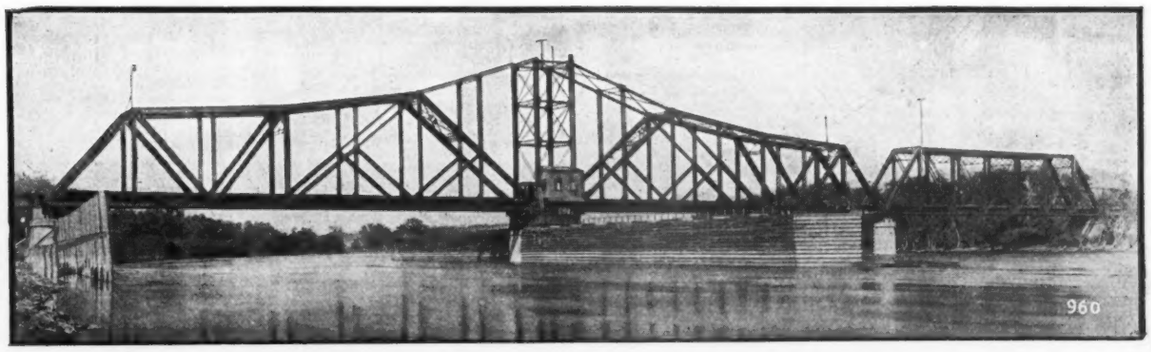

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H.P.			Speed
1	1	Gen. Elec., 110 v	1800
2	1	Gen. Elec., 220 v	1800
1	1	Gen. Elec., 550 v	1800
4	2	Gen. Elec., 220 v	1800
2	2	Gen. Elec., 220 v	1200
2	5	Gen. Elec., 220 v	1800
1	7½	Gen. Elec., 220 v	1800
1	7½	Westinghouse variable, 220 v	900
1	10	Triumph, 220 v	1140
1	10	Gen. Elec., 550 v	1200
2	10	Gen. Elec., 220 v	1200
1	15	Westinghouse, 220 v	1120
2	15	Gen. Elec., 220 v	1200
1	20	Westinghouse, 220 v	1120
5	20	Gen. Elec., 220 or 440 v	1200
1	20	Westinghouse, 220 or 440 v	1120
1	20	Allis-Chalmers, 220 or 440 v	850
1	20	Westinghouse, variable, 220 or 440 v	900
11	25	Gen. Elec., 220 or 440 v	900
3	30	Westinghouse, 220 v	1120
3	30	Westinghouse, 440 v	1120
1	30	Westinghouse, 220 or 440 v	840
3	30	Allis-Chalmers, 220 or 440 v	850
4	40	Gen. Elec., 220 or 440 v	900
4	40	Westinghouse, 220 or 440 v	850
3	40	Westinghouse, vertical, 220 or 440 v	850
2	45	Burke, 220 or 400 v	600
1	50	Westinghouse, 220 v	840
1	50	Ft. Wayne, 220 v	900
1	50	Westinghouse, 220 or 440 v	850
1	50	Allis-Chalmers, 220 or 440 v	850
4	65	Gen. Elec., 220 or 440 v	720
2	75	Westinghouse, 220 or 440 v	850
2	100	Westinghouse, 220 or 440 v	690
1	100	Gen. Elec., 220 or 440 v	600
1	125	Gen. Elec., 550 v	600
2	125	Gen. Elec., 220 or 440 v	600
1	125	Gen. Elec., 2200 v	600

Three-Phase, 25-Cycles

H.P.		Speed
1	5	Fairbanks-Morse, 440 v.	720
1	15	Burke, 440 v.	720
1	15	Bullock, 440 v.	720
1	20	Westinghouse, 440 v.	720
1	20	Gen. Elec., 440 v.	720
1	100	Westinghouse, 440 v.	480
2	150	Westinghouse, 440 v.	480
2	200	Westinghouse, 440 v.	480
1	200	Westinghouse, 2200 v.	480

Bargains for Sale

125-133 Cycle Alternators

K.W.			Speed
1	30	Gen. Elec., A. 30	1500
1	30	Gen. Elec., A.S. 30	1500
1	33	Ft. Wayne, W.A.L.	1680
1	30	National	1500
2	60	Gen. Elec., A. 60	1500
2	60	Gen. Elec., A.S.	1500
1	60	Westinghouse	1650
1	75	Ft. Wayne, W.A.	1050
3	90	Gen. Elec., A.S.	1250
2	90	Westinghouse	1143
2	120	Gen. Elec., A. 120	1070
1	120	Westinghouse	1375
1	150	Ft. Wayne, W.A.L.	700
1	200	Westinghouse	571

60-Cycle Alternators

K.W.		Speed
1	15 Ft. Wayne	1800
1	40 Westinghouse	900
1	45 Westinghouse	900
1	60 Westinghouse	900
1	60 Gen. Elec., A.S.	900
1	75 Westinghouse	600
1	75 Westinghouse	720
1	75 Ft. Wayne, W.A.L.	600
1	100 G. E., A.P., 3-ph.	900
2	100 G. E., A.T., 3-ph.	900
1	120 G. E., A.S., 120	900
2	150 Westinghouse, 2-ph.	600
1	175 Stanley, 2-ph.	514
1	200 Westinghouse, 3-ph.	600
2	300 Gen. Elec., A.S.B.	450
1	185 Gen. Elec., 220 v. D.C. 2200 v. A. C. synchronous motor, generator outfit, with switchboard	600

25-Cycle Alternators

K.W.		Speed
1	130 Westinghouse, 3-ph.	500
1	275 Westinghouse, 3-ph.	375
2	440 Westinghouse, 3-ph.	300
1	100 H.P. West. 3-ph.motor	480
1	150 H.P. West. 3-ph.motor	480
1	200 H.P. West. 3-ph.motor	480

250-Volt D. C. Generators

K.W.			Speed
1	4½	Northern	1800
1	6	Northern	1600
1	6	Roth	1050
6	7½	National	1350
1	8	Fairbanks-Morse, dir.-con. Racine engine	375
2	8½	Northern	950
6	10	National	1150
1	12	Thresher	900
1	15	Western Elec.	700
1	15	Northern	700
1	17½	Crocker-Wheeler	1400
1	17½	Northern	1100
1	20	Eddy	800
1	20	Commercial	750
1	20	C. & C. dir.-con. Chandler-Taylor engine	320
1	22½	Bullock	700
2	30	Western Elec.	1250
1	30	Bullock	1300
1	30	Bernard	575
1	35	Triumph	900
1	35	Northern	950
1	50	C. & C.	275
2	60	Ft. Wayne, dir.-con. to Harrisburg self-oiling engine	300
2	75	Westinghouse	750
1	100	Jenny, dir.-con., All-free engine	250

Arc Machines

K.W.		Speed
1	25 Ft. Wayne, 9.6 amp.	1000
1	40 Ft. Wayne, 9.6 amp.	1000
1	125 Brush, 6.6 amp. No. 11	480
1	125 Brush, 9.6 amp. No. 11	480

550 Volt M. P. Comp Generators

K.W.		Speed
2	16 Sprague-Lundell	1450
1	22½ Westinghouse	975
1	25 Triumph, M.P.	950
1	100 Gen. Elec.	650
1	150 Northern	625
1	200 Westinghouse, 6-pole.	510
1	250 Westinghouse, 6-pole.	450

Steam Engines

H.P.		Speed
1	150 Bass Corliss, 16x12	85
1	150 Ideal, 14x14	275
1	150 McEwen, 14x14	275
1	250 Ideal, 16x16	250
1	300 Westinghouse, comp.	250

220-Volt D. C. Motors

H.P.			Speed
7	⅛	West. Elec.	1500
1	¼	Gen. Elec.	1800
1	1	Watson, vertical	900
1	1½	Northern, variable	1400
3	1½	General Electric	800
1	2	West. Elec., crane	900
1	2	Edison	900
1	2	Northern, series	1000
1	2	Fidelity	1000
28	2	Watson	1200
1	2	Northern, vertical	550
1	2½	Northern	1500
1	2½	Northern	1000
1	3	Peerless	1450
2	3	General Electric	1800
11	3	National	1450
1	3	Excelsior, enclosed	1000
1	3	Crocker-Wheeler	1000
2	3	Watson	1050
22	3	National	1000
1	4	Northern, series	1000
1	4	General Electric	725
1	5	National	1900
1	5	Northern	1450
2	5	Bullock	1050
25	5	National	1100
86	5	National	950
1	5	General Electric	675
1	5	Holtzer-Cabot	550
1	5	Northern, interpole	1500
1	6	Thompson-Houston	650
14	7½	National	1500
2	7½	Northern	1500
1	7½	Fidelity	850
1	7½	Aaron	750
1	7½	Northern	1200
1	7½	General Electric	1525
1	7½	Sprague-Lundell	1525
1	7½	Westinghouse	1350
1	7½	Card	775
69	7½	National	900
8	7½	National	900
1	7½	Roth	860
1	7½	Jenney	700
1	7½	Commercial	540
1	8	Triumph	720
1	10	Fidelity	1200
19	10	National	1500
1	10	Storey, enclosed, cr'e	600
1	10	Robbins & Myers	1030
20	10	National	950
2	10	Northern	800
94	10	National	800
1	12	Barriet	1400
1	13	Burke	650
1	15	Thresher	760
1	15	Westinghouse	1675
15	15	National	1300
1	15	Northern	1200
2	15	Bullock	900
3	15	Ruth	770
31	15	National	725
1	15	General Electric	635
1	18	Western Electric	650
1	20	Sprague	1100
1	20	Willey	1150
1	20	Ft. Wayne	1250
1	20	Northern	950
1	20	Aaron	750
1	20	Crocker-Wheeler	1250
1	20	Card	750
2	20	Crocker-Wheeler	775
1	20	Northern	675
1	20	Gibbs	600
2	20	National	925
30	20	National	625
1	25	Thomson-Houston	1300
1	25	Siemens & Halske	970
1	25	Bullock	1400
1	25	Eddy	725
1	25	Crocker-Wheeler	1025
1	25	Crocker-Wheeler	750
1	25	Commercial	650
2	25	Electron	380
6	30	Walker, series	90
9	30	National	575
1	35	Western Electric	950
1	35	Western Electric	1050
1	35	Bullock	1150
1	35	Bernard	525
1	40	Triumph	800
1	40	Northern	775
1	60	C. & C.	235
1	100	Westinghouse, S.	650
1	100	Westinghouse, M.	700

550-Volt Motors

H.P.		Speed
1	2 General Electric	2000
3	3 General Electric	1800
1	4½ Aaron	1780
1	5 Card	1025
1	5 General Electric	1200
1	5 Northernback-gear'd 97–18, shaft speed	190
1	6 Jenney	1400
2	6½ Crocker-Wheeler	1325
1	7½ Wagner	1450
1	7½ General Electric	1650
2	7½ Northern, variable speed	400–1600
1	8 Northern	1475
3	10 National	1600
2	10 General Electric	1500
1	10 Holtzer-Cabot	1275
1	10 Northern	775
2	10 National	950
1	12 Jenney	1600
1	12 Thomson-Houston	1400
1	12 Northern	850
1	15 Jenney	1500
1	15 Commercial	1200
1	15 Paragon	1200
1	15 Sprague-Lundell	1200
1	15 Gibbs	725
1	15 Westinghouse	650
1	30 Milwaukee	1075
1	30 Triumph	830
2	30 Westinghouse	975
1	35 General Electric	975
1	35 General Electric	600
1	40 Crocker-Wheeler	725
2	50 Electron	800
1	50 General Electric	900

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7— 50	HP General Electric, 220 volts, 720 RPM.	3— 10	HP Westinghouse, 220 volts, 1120 RPM.
2— 50	HP Westinghouse, 200 volts, 850 RPM	1— 10	HP General Electric, 220 volts, 1200 RPM.
1— 50	HP Westinghouse, 220 volts, 850 RPM.	1— 10	HP Westinghouse, 200 volts, 1120 RPM.
3— 40	HP Westinghouse, 220 volts, 850 RPM.	1— 10	HP General Electric, 200 volts, 900 RPM.
1— 35	HP General Electric, 220 volts, 900 RPM.	1— 5	HP Westinghouse, 220 volts, 1120 RPM.
1— 30	HP Westinghouse, 200 volts, 1120 RPM.	1— 3½	HP Richter, 1800 RPM.
1— 25	HP Stanley, 1200 RPM.	1— 3	HP Westinghouse, 220 volts, 1120 RPM.
1— 20	HP Ft. Wayne, 220 volts, 1200 RPM.	1— 3	HP General Electric, 110 volts, 1800 RPM.
1— 20	HP Westinghouse, 220 volts, 1120 RPM.		

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SWITCHBOARD and panel board engineer and thoroughly experienced man wants executive position in this line, where expert knowledge and ability will gain advancement; experienced draftsman, competent estimator, good salesman, correspondent and advertiser; have designed several lines of apparatus and written catalogues; eight years' experience as sociate member A. I. E. E. Address No. 6432, care of Electrical World, New York.

POSITION desired by young man; 10 years' experience with large electric light corporation as auditor, secretary and treasurer; thoroughly familiar with modern methods of accounting, accounting system of N. E. L. Association and requirements of public service commissions of New York, Massachusetts, Wisconsin, Interstate Commerce; excellent references. Address No. 6437, care of Electrical World, New York.

HIGH-CLASS designing, constructing and operating engineer desires change; high-head and high-tension hydroelectric and transmission work a specialty; work covers one of the largest high-head plants in United States, also 110,000-volt station; open for position Jan. 15. Address No. 6441, care of Electrical World, 590 Old Colony Bldg., Chicago, Ill.

(*Continued on page 76.*)

HELP WANTED

(*Continued from page 75.*)

The rate for "Help Wanted" advertisements of forty words or less is one dollar and fifty cents an insertion; additional words three cents each, payable in advance. Remittances and copy should reach this office not later than Monday, 12 o'clock noon, for the next succeeding issue.

Replies may be sent in care of Electrical World, 239 West Thirty-ninth Street, New York, or 590 Old Colony Building, Chicago, as advertisers may desire.

(In replying to a "Want" advertisement, original letters of recommendation should NOT be forwarded.)

WANTED.—Chief draftsman for a railway, light and power company in Mexico; applications will only be considered from those familiar, both electrically and mechanically, with all branches of building construction, power plant design, distribution systems, overhead and underground and track work; one speaking Spanish preferred; state salary. Address No. 6418, care of Electrical World, New York.

HELP WANTED.—An up-to-date bookkeeper and accountant to commence duty March 1 for a progressive New England central station having about 28,000 light and power customers. Address No. 6402, care of Electrical World, New York.

WANTED.—Skilled Electrical Tester for permanent position with General Electric Company, West Lynn, Mass. Application stating age, education, experience and initial compensation expected should be addressed to M. W. A., General Electric Company, West Lynn, Mass.

WANTED.—High-grade, experienced salesman to travel for electrical supply house; must be a hustler and have thorough knowledge of the supply business; one with acquaintances in Southern States preferred. Address, stating experience and reference, Box 201, New Orleans, La.

WANTED.—A general superintendent for a large manufacturing company in Southern New England; salary $4,000 to $5,000 per year. Address No. 6406, care of Electrical World, New York.

WANTED.—TELEGRAPH SUPERINTENDENT; no knowledge of wireless telegraphy necessary; must be good organizer and familiar with telegraph circuits and instruments. National Electric Signaling Co., Brant Rock, Mass.

WANTED.—By an electrical engineering and construction firm of good standing, a competent estimator; must be quick and accurate and experienced in general construction work; give age, experience, references and salary expected. Address No. 6416, care of Electrical World, 590 Old Colony Bldg., Chicago, Ill.

WANTED.—First-class, A1, energetic salesman for well-established Toronto firm, dealing in engineering, electrical and mill supplies; man must be familiar with office routine and management, and have sufficient executive ability to eventually take the position of sales manager; state age, experience and salary expected. Address No. 6415, care of Electrical World, New York.

WANTED.—An experienced superintendent lighting department of a railway and light company in city of 75,000; must be competent to direct general supervision of power stations, both turbine and engine, substations, and distributing system; technical graduate preferred; write, giving complete experience and salary. Address No. 6387, care of Electrical World, New York.

COMPANY, manufacturing complete line of incandescent lamps, wants to secure services of several first-class agents and salesmen. Address No. 3320, care of Electrical World, New York.

WANTED.—Sales manager, must be a civil or mechanical engineer, for structural transmission towers; opportunity of lifetime for right man with large, old-established company; no one need apply who is not an experienced, eminently successful salesman in the structural transmission tower business; applicants must state fully qualifications, references, etc.; all answers will be treated in strict confidence. Address No. 6421, care of Electrical World, New York.

DESIGNER WANTED.—A particularly able designer of alternating-current generators and motors for a leading position in a well-known electrical manufacturing company near New York. Address No. 6246, care of Electrical World, New York.

METER MAN.—Wanted, men interested in meter and instrument work to take up the course on "Electrical Measuring Instruments and Meters," as prepared by the Fort Wayne Electrical Correspondence School, Fort Wayne, Ind. Write for catalogue giving information on meter testing.

CHICAGO agent wanted by an importer and manufacturer of mica; applicant should have established connections with mica buyers in Chicago and the West. Apply with full particulars to No. 6448, care of Electrical World, New York.

SUPERINTENDENT OF CONSTRUCTION, EXPERIMENTERS, WIRELESS OPERATORS.

WANTED.—Superintendent and assistant superintendent of construction; no knowledge of wireless necessary; engineers for experimental work having good knowledge of electricity and experience in practical work; first-class wireless operators as assistants to superintendent of operating department; salaries from $100 to $250 per month, according to ability; only first-class men should apply; executive ability and good judgment of more importance than experience in wireless work. R. A. Fessenden, National Electrical Signaling Company, Brant Rock, Mass.

AN ELECTRICIAN of ability and energy, a skilful director of men, with a few thousand dollars, can secure permanent connection as general manager and large interest in a going business, New York City; owning patent that will be a big money-maker; particulars and references exchanged; write at once. Address "Secretary," No. 6435, care of Electrical World, New York.

INCANDESCENT lamp salesman; we want a first-class man who knows the lamp business to sell tungsten, tantalum and carbon lamps in New York; fine opportunity for a hustler who can produce results; commission to start; salary when you make good. Address No. 6366, care of Electrical World, New York.

WANTED.—A man thoroughly familiar with interior electrical construction to act as superintendent; must be energetic, ambitious and methodical; capable of handling men and informed on best methods of construction; one familiar with rules and requirements of Boston preferred; state fully experience and salary expected; good opportunity for right man. Address No. 6426, care of Electrical World, New York.

WANTED.—Illuminating engineer for Mexico, thoroughly familiar with all types of illuminating and distribution systems for same in large cities; one who speaks Spanish preferred; state salary. Address No. 6431, care of Electrical World, New York.

DRAFTSMAN.—Exceptional opportunity for a first-class man capable of designing small electrical apparatus; a man with at least 10 years' practical experience preferred. Write, stating age and experience, to No. 6429, care of Electrical World, New York.

WANTED.—By a large Eastern road, a technical graduate to take charge of a department covering the instruction of motormen in the proper handling of the electrical equipment and the following up and keeping records of the results obtained by individual motormen, with a view of improving the handling of the equipment and reducing maintenance of equipment cost; only men of experience and executive ability need apply. Address Supt. Motive Power, P. O. Box 5227, Boston, Mass.

WANTED.—Manager for electrical repair shop; must have business experience and be thoroughly trained in the repairing and rewinding of all types of generators and motors and the manufacture of armature and field coils and capable of estimating cost of repair work; a good opening for a good man; state fully particulars as to training, education and salary expected. Address No. 6443, care of Electrical World, New York.

WANTED.—A young man familiar with work in contract department of central station to take charge of a branch office in Greater New York; good opportunity for the right man. Address No. 6450, care of Electrical World, New York.

WANTED.—Experienced operators for alternating-current power stations; also for substations; state experience and present salary. Address G. 17—1300 Trude Bldg., Chicago, Ill.

WANTED.—Experienced man to take charge of the electrical supply department of established company; must be a hustler and have thorough knowledge of the electrical supply business; write fully, giving age, experience and salary wanted. Address No. 6444, care of Electrical World, New York.

EDUCATIONAL

The rate for "Educational" advertisements of forty words or less is one dollar and fifty cents an insertion; additional words three cents each, payable in advance. Remittances and copy should reach this office not later than Monday, 12 o'clock noon, for the next succeeding issue.

RENSSELAER POLYTECHNIC INSTITUTE, TROY, N. Y.—Courses in Civil, Mechanical and Electrical Engineering, and General Science, leading to the degrees of Civil Engineer (C. E.), Mechanical Engineer (M. E.), Electrical Engineer (E. E.), and Bachelor of Science (B. S.). Special courses in Engineering and Science. Splendidly equipped new engineering laboratories. Send for Catalogues to the Registrar.

NOTRE DAME UNIVERSITY, NOTRE DAME, IND.—Four-year courses in Electrical, Mechanical, Mining, Civil and Chemical Engineering. Short (two-year) Courses in Electrical and Mechanical. Fully equipped Shops and Laboratories. Experienced Professors. Graduates always in demand. Catalogue free on request.

MISCELLANEOUS

The rate for "Miscellaneous" advertisements of forty words or less is one dollar and fifty cents an insertion; additional words three cents each, payable in advance. Remittances and copy should reach this office not later than Monday, 12 o'clock noon, for the next succeeding issue.

ELECTRICAL INVENTORS should engage a *technical* patent attorney to apply for their patents, because Patent Office Examiners are *technical* experts. No Examiner, nor other attorney than undersigned is member of both A. I. E. E. and A. S. M. E. Mail invention for free advice, opinion, booklet and estimate to secure patent. Delay dangerous. Edward P. Thompson, M. E., Registered Patent Attorney, 1371 Columbia Road, Washington, D. C.

WANTED.—Meter testers to send for our new meter testing book giving full information on connecting and testing meters. This book, sent free upon request, will enable you to increase the efficiency of the meter department. Central Electric Co., Chicago.

FOR SALE.—Electric light plant in live town of 5000 inhabitants in western Pennsylvania; splendid opportunity for right man. Address No. 6436, care of Electrical World, New York.

TO MANUFACTURERS OF ELECTRICAL GOODS.—A company now well established in the Northwest and carrying a stock of staple goods for Eastern factories wishes to add to their exclusive agencies any line not now being sold at all or in satisfactory quantity in the Northwest. Address No. 6440, care of Electrical World, New York.

PROPOSALS

The rate for "Proposal" advertisements is 15 cents per line, payable in advance. Remittances and copy should reach this office not later than Monday, 12 o'clock noon, for the next succeeding issue.

DEPARTMENT OF THE INTERIOR, Washington, D. C., December 16, 1909. Sealed proposals in duplicate will be received at the Department until 2 o'clock P. M., Friday, January 21, 1910, for remodeling the power plant, Government Hospital for the Insane, Washington, D. C., in accordance with the drawings and specifications, copies of which, with form of proposal, may be had on application at the Department. The right is reserved to reject any or all bids, waive technical defects, or to accept one part and reject the other, as the interests of the Government may require. Proposals must be marked "Proposals for remodeling power plant, Government Hospital for the Insane." J. E. WILSON, Assistant Secretary.

NOTICE OF SEALED PROPOSALS.

Notice is hereby given that the Board of Public Works will receive sealed proposals at the Council Chambers in the City Hall of the City of Hammond, Indiana, between the hours of 9:30 A. M. and 10:00 A. M. on Thursday, December 30th, 1909, for lighting the streets, alleys and public buildings of the City of Hammond, Indiana, and for the furnishing of electric current for lighting, power, heating and other purposes to the inhabitants of said City for a term of ten and twenty years, in accordance with specifications on file in the office of the City Clerk on and after December 15th, 1909.

Proposals must be made on printed forms and accompanied by a certified check of One Thousand Dollars, payable to the Treasurer of the City of Hammond, Indiana.

ADAM R. EBERT,
JACOB SCHLOER,
PETER L. DAVIS,
Board of Public Works.

(*Continued on page 77.*)

Frank MacGovern J. Warren Archer

MacGovern, Archer & Co.

114-118 Liberty Street Electrical and Steam Machinery **NEW YORK**

DYNAMOS AND MOTORS—ALL IN STOCK PHONE, CORT. 5577

Turbo-Generator Sets

1—5000 KW, Curtis G. E., 3-phase, 60-cycle, 2300-6600 volts.
2—2000 KW, Curtis G. E., 3-phase, 25-cycle, 6600 volts.

A. C. Direct-Connected Units (60-Cycle)

1—500 KW, G. E., 3-phase, ATB, 150 RPM, 2300 volts, with C. C. McIntosh & Seymour engine.
1—300 KW, G. E., 3-phase, ATB, 150 RPM, 2300 volts, with 14&23x30 in. C. C. McIntosh & Seymour engine.
2—200 KW, ATB, 3-phase, 60-cycle, 2300-volt G. E. alter., each direct-connected to a DeLaval steam turbine.
2—250 KW, 2200-volt, 3-phase, 60-cycle Westinghouse alternators, each direct-connected to 16&27x16 in. Westinghouse compound vertical engine.
1—150 KW, Westinghouse, 2-phase, 60-cycle, 220-volt, 341 amperes, 240 RPM, with 22x16 Ball & Wood 4-valve horizontal engine. Can be rewound for 2300 volts, 3-phase.
1—75 KW, West., 1-phase, 60-cycle, 2200-volt, 257 RPM, with 13x12 Ames auto. engine. Can be rewound for 3-phase.

Alternating Current Dynamos (Belted), 3-Phase

1—300 KW, 3-phase, G. E., 60-cycle, 2300-volt, 450 RPM, ATB.
1—100 KW, 3-phase, G. E., 60-cycle, 480-volt, 900 RPM, ATB.
1— 75 KW, 3-phase, G. E., 60-cycle, 2300-volt, 900 RPM, ATB.

Alternating Current Dynamos (Belted), 2-Phase

1—180 KW, 2-phase, West., 60-cycle, 2300-volt, 514 RPM.
2— 75 KW, 2-phase, West., 60-cycle, 2200-volt, 720 RPM.

Alternating Current Dynamos (Belted), 1-Phase

1—100 KW, 1-phase, G. E., 60-cycle, 900 RPM, 1150-volt.
2— 75 KW, 1-phase, G. E., 60-cycle, 900 RPM, 1150-volt.
1— 45 KW, 1-phase, G. E., 60-cycle, 900 RPM, 2300-volt.

Direct Current Direct-Connected Units

2—400 KW, Westinghouse, 10 pole, 250 volts, 150 RPM, each direct-connected to an 18&36x30 in. Porter Allen engine.
2—225 KW, Westinghouse, 8 pole, 575 volts, 250 RPM, each direct-connected to an 18&30x16 in. vertical Westinghouse engine (Rites governor).
1—200 KW, Westinghouse, 8 pole, 250 volts, 250 RPM, direct-connected to 18&30x16 in. vertical Westinghouse engine fitted with Rites governors.
1—150 KW, Crocker-Wheeler, 115-125 volts, 6 pole, speed 250, 160 RPM, each with a heavy duty 4-valve type horizontal McIntosh & Seymour engine.
1—100 KW, General Electric, 125 volts, 6 pole, speed 250 RPM, with 16x15 in. horizontal McIntosh & Seymour engine.
1—50 KW, Crocker-Wheeler, 6 pole, 125 volts, 275 RPM, direct-connected to an 11x14 in. horizontal straight line engine.

Vertical Direct-Connected Units

3—100 KW, Sturtevant, 250 volts, 350 RPM, engines 10&18x10
1— 50 KW, Sturtevant, 250 volts, 400 RPM, engine 8&14x8 in.
2— 50 KW, Sturtevant, 115 volts, 275 RPM, engines 12x10 in.
2— 35 KW, Sturtevant, 115 volts, 325 RPM, engines 10x9 in.
2— 30 KW, G. E., 125 volts, 305 RPM, engine 11x8 in.
2— 20 KW, G. E., 125 volts, 360 RPM, engine 9x7 in.

250-Volt Direct Current Dynamos and Motors

3—415 HP, Bullock, 10-pole, 155-175 RPM.
1—150 KW, C.-W., 6-pole, 550 RPM.
1—125 HP, Bullock, 6-pole, 225 RPM.
1—60 KW, Northern, 4-pole, 800 RPM.
1—15 HP, G. E., 4-pole, type CE, form A, 1200 RPM.

500-Volt Direct Current Dynamos and Motors

1—300 KW, G. E., 4-pole, type MP, 400 RPM.
1—110 KW, G. E., 6-pole, form A, 600 RPM.
1—85 HP, G. E., 4-pole, form H, 500 RPM.
2—55 HP, G. E., 6-pole, type CL, form B, 900 RPM.
1—50 HP, West., 4-pole, type S, 550 RPM.
1—30 HP, West., 4-pole, type S, 950 RPM.
1—25 HP, C.-W., 4-pole, type CM, 780 RPM.
2—15 HP, G. E., 4-pole, type CQ, form A, 1200 RPM.
1—20 HP, Northern, 4-pole, type MP, 850 RPM.
1—10 HP, Northern, 4-pole, 850 RPM.
1—7½ HP, G. E., 4-pole, 800 RPM.
3—5 HP, G. E., 4-pole, type CE, 1800 RPM.
1—3 HP, G. E., 4-pole, 1620 RPM.
1—1 HP, G. E., 2-pole, type CA, form B, 1300 RPM.

3-Phase, 60-Cycle Motors

1—125 HP, West., type C, 2200 volts, 720 RPM.
1—85 HP, G. E., form L, 2300 volts, 900 RPM.
2—7½ HP, West, type C, 20 volts, 1120 RPM.
1—2 HP, West., type C, 110 volts, 1700 RPM.

2-Phase, 60-Cycle Motors

1—125 HP, Westinghouse, type C, 2200 volts, 720 RPM.
2—55 HP, General Electric, form K, 220 volts, 514 RPM.
3—20 HP, General Electric, form K, 220 volts, 900 RPM.
3—15 HP, General Electric, form K, 220 volts, 1200 RPM.
4—10 HP, General Electric, form K, 220 volts, 1200 RPM.
1—7½ HP, General Electric, form K, 220 volts, 1200 RPM.
2—3 HP, Westinghouse, type C, 200 volts, 1700 RPM.
2—2 HP, Westinghouse, type C, 200 volts, 1700 RPM.

Engines

1—22 & 44x48 Whitehill Corliss T. C., Tangye frame, 750 HP.
1—18 & 36x48 Whitehill Corliss T. C., Tangye frame, 500 HP.
1—16 & 27x16 Westinghouse vertical, 300 HP.
2—11 & 19x12 Ball & Wood, 4-valve, 150 HP.
1—15x16 McIntosh & Seymour, 150 HP.
1—13x12 Ames Auto., 125 HP.
1—13x12 Erie City Auto., 100 HP.

Boilers

4—450 HP Babcock & Wilcox, 180 lbs. pressure. Water tube boilers fitted with Roney Stokers. Can ship immediately.

All the above Machinery can be delivered immediately and is in the very best of condition. Send for full list of 2 and 3-phase Alternating and 550 or 250 volt Direct Current Motors; also Dynamos, Engines and Electrical and Steam Machinery of every description

PROPOSALS

(*Continued from page 76.*)

THE SANITARY DISTRICT OF CHICAGO.

TO CONTRACTORS.

SEALED PROPOSALS ADDRESSED TO THE BOARD OF TRUSTEES OF THE SANITARY DISTRICT OF CHICAGO AND INDORSED

"PROPOSALS FOR MOTOR GENERATOR SET FOR OPERATION OF EIGHT TRACK BRIDGE AND WESTERN AVENUE BRIDGE OVER THE MAIN DRAINAGE CHANNEL; AND FOR GEARING, SHAFTING, BEARINGS AND INDUCTION MOTOR FOR PUMPING STATION AT THIRTY-NINTH STREET AND LAKE MICHIGAN, IN CHICAGO, ILLINOIS," will be received by the clerk of said Sanitary District at Room 1500, American Trust Building, Chicago, Ill., until 12 M., standard time, on Wednesday, Dec. 29, 1909, and will be publicly opened by the Board of Trustees, at a meeting to be held on that day, or the first meeting thereafter.

Proposals may be made on any or all of the following Divisions:

Division A—Motor Generator Set.
Division B—Gearing.
Division C—Shafting and Bearings.
Division D—Induction Motor.

All proposals must be made upon blank forms, furnished by said Sanitary District and in accordance with the plans, specifications and contract form on file in the office of the Electrical Engineer of said Sanitary District at Room 1500, American Trust Building, Chicago, Ill. Said plans, specifications and form of contract, bond and proposal may be obtained upon application therefor.

All proposals must be delivered at the office of said Clerk of said Sanitary District in a sealed package, addressed to "The Board of Trustees of The Sanitary District of Chicago," and indorsed, "Proposals for Division 'A,' 'B,' 'C,' or 'D,'" as may be covered by the proposal.

The bids upon each and any of said Divisions shall be considered as separate and distinct from all others, and separate certified check or cash, equal to ten (10%) per cent of the amount bid upon each Division, shall be deposited with the bids thereon and shall accompany the proposal. All certified checks must be drawn on some responsible bank, doing business in the City of Chicago, and shall be made payable to said The Sanitary District of Chicago.

Said amounts deposited with bids will be held by said Sanitary District until all the respective bids for said work have been canvassed, and the contracts awarded and signed. The return of said checks or cash to the bidder, to whom all or any part of said work shall be made, is conditioned upon the appearance of such bidder within ten (10) days after receiving notice of such award, with bondsman, and executing a contract with said Sanitary District for the work so awarded and giving bond satisfactory to said Board of Trustees, for the faithful performance of such contract, for an amount equal to fifty (50%) per cent of the contract price.

Said Board of Trustees reserves the right to reject any and all proposals.

THE SANITARY DISTRICT OF CHICAGO,
By ROBERT R. MCCORMICK,
President of Its Board of Trustees.

Attest:
I. J. BRYAN, *Clerk.*
Chicago, December 14, 1909.

It's Not Too Late

A subscription for the ELECTRICAL WORLD is the best Christmas Gift for an Electrical Man.

If you will send your orders ***to-day,*** we can enter subscriptions to begin with the issue of December 30th or January 7th. Your friends would rather have the ELECTRICAL WORLD a little after Christmas than to get ***anything else on time.***

For each new yearly subscription you send us, remitting $3.00 and referring to this advertisement, we will extend your own subscription three months.

If ***you*** are not already a subscriber for the WORLD, it will pay you to give yourself a subscription for 1910. You will find every issue of vital interest, and it will help you in your work.

Subscribe To-day

Electrical World, 239 West 39th Street, New York

Attractive Propositions

Direct Connected Units

(250 VOLTS)	(125 VOLTS)
1—125 K.W., Westinghouse, d. c. Ames tandem compound engine.	1—100 K.W., General Electric, d.c. Watertown engine.
1—100 K.W., Crocker Wheeler, d.c. Payne engine.	1— 60 K.W., General Electric, d.c. Watertown engine.
1— 50 K.W., Triumph, 6-pole, d.c. Buffalo Forge Engine.	1— 40 K.W., Sprague, d.c. Fitchburg vertical engine.

Belted

(250 VOLTS)	(125 VOLTS)
1—100 K.W., Westinghouse, 6-pole.	1— 75 K.W., General Electric.
1— 75 K.W., General Electric.	1— 60 K.W., Eddy.
1— 50 K.W., General Electric.	1— 50 K.W., General Electric.
2— 30 K.W., Westinghouse.	1— 45 K.W., Westinghouse.
	1— 25 K.W., General Electric.

Large stock of Motors, Generators, Engines and Boilers.

Correspondence Solicited

Joseph H. Thompson, Jr., 17 BATTERY PLACE NEW YORK

FOR SALE

1—120 K.W., 720 RPM., 2 phase, 60 cycle, 2300 v. Westinghouse alternator.
1—110 K.W., 600 RPM., 240 volt, General Electric generator.
1—125 K.W., 650 RPM., 240 volt, type G, Eddy generator.
1—105 H.P., 250 v., 700 RPM., type C.L., General Electric motor.
1— 75 H.P., 1200 RPM., 2300 volt, 60 cycle, type I.Q., form L, General Electric motor.
1— 60 K.W., 1200 RPM., 2 phase, 60 cycle Bullock alternator, 2200 volts.
1— 75 H.P., General Electric, 750 RPM, 250 volt generator.
2— 15 H.P., 900 RPM., 220 volt, General Electric 2 phase motors, direct connected to centrifugal pumps.

WE BUY, SELL AND EXCHANGE.

GEORGE SACHSENMAIER
1309 RACE ST., PHILA., PA.

FOR SALE

DYNAMOS

MOTORS METERS

ARC LAMPS

TRANSFORMERS

ELECTRICAL SUPPLIES

We **rent Electrical Machinery.**

We **repair all makes** of Electrical **Apparatus.**

Send for our **latest** complete **bargain book** and **net prices.**

Guarantee Electric Co.

Adams and Clinton Sts. CHICAGO

EDWIN R. ROCKWELL, General Manager

Bargains in G-I Arc Lamps

5,000 new and used lamps at less than half original cost.

Direct Connected Sets

125-Volt Lighting Sets

1—33 K.W. C. & C. Generator and 10 x 10 Ames Engine.
1—50 K.W. Jenney Generator and 12 x 12 Ames Engine.
1—75 K.W. Westinghouse Generator and 13 x 12 Ames Engine.
1—100 K.W. Western Elec. Generator and 16 x 16 N. Y. Safety Engine.
1—200 K.W. Western Electric Generator and 20 x 24 Atlas Engine.

250-Volt Power Units

1—60 K.W. Western Electric and 13 x 13 Ideal Engine.
1—115 K.W. G. E. Generator and 14 x 36 Allis Corliss Engine.
1—175 K.W. G. E. Generator and 18 x 16 Ames Engine.
1—300 K.W. Northern Generator and T. C. Russell 4-valve Engine.

250-Volt, 60-Cycle, 3-Phase Sets

1—125 K.W. Western Electric Generator and 16 x 16 Skinner Automatic Engine.

POWER EQUIPMENT COMPANY

1407 Fisher Bldg. CHICAGO

DIRECT CONNECTED ELECTRICAL APPARATUS

ALTERNATING CURRENT DIRECT CONN.

K.W.	MAKE	VOLTS	PH	CY	SPEED	ENGINE MAKE
1000	GEN. ELEC..	2300	3	60	100	MAC-I & SEY. C. C.
800	GEN. ELEC..	1200	1	60	90	HAM. C. C.
800	WESTG.....	2200	2–3	60	...	L. ERIE C. C. V.
325	WALKER.....	2300	2–3	60	120	ERIE C. C.
300	WESTG.....	2300	2–3	60	212	WESTG. C. C.
2–250	WESTG.....	2300	2–3	60	257	WESTG. C. C.
200	GEN. ELEC..	480	3	25	250	B & W.
2–200	GEN. ELEC..	2400	3	60	900	DE LAVAL
150	GEN. ELEC..	2300	3	60	257	H'BG. T. C.
125	WES. ELEC..	240	3	60	257	16″ x 16″ SK. R.
50	GEN. ELEC..	2400	1–3	60	300	ERIE BALL 11 & 19x12

DIRECT CURRENT DIRECT CONN.

K.W.	MAKE	VOLTS	POLES	SPEED	ENGINE MAKE
850	GEN. ELEC.....	250	12	120	WILLIAMS
500	GEN. ELEC.....	500	10	90	MAC-I & SEY. T. C.
400	GEN. ELEC.....	600	8	150	PORTER-ALLEN SIM.
300	NORTHERN.....	250	10	150	RUSSELL T. C. 4V.
250	WESTGH.....	500	10	100	HAM. T. C.
200	WESTGH.....	250	8	200	ERIE BALL C. C. V.
200	CROC.-WH.....	125	6	175	McEWEN. 20 x 20
200	GEN. ELEC.....	575	8	120	18 x 36 FULTON
150	WESTH.....	125	8	200	FULTON 4 V.
150	WESTH.....	550	8	180	RUSSELL 4 V.
75	WESTH.....	125	6	300	WESTH. C. C. V.

ALL OF THE ABOVE READY FOR IMMEDIATE DELIVERY AT BARGAIN PRICES.

ST. LOUIS **ARTHUR S. PARTRIDGE** **NEW BANK OF COMMERCE BLDG.**

Steel Smoke Stack for Sale

95 ft. high, 5 ft. top, nearly new. Will be sold at a sacrifice. Also all kinds of second-hand steam and electrical machinery bought and sold for spot cash.

H. WERBY

35 Elmo Street - - - Dorchester, Mass.

150 K.W. 2 Phase

Revolving field type "AQB" 2300 volt, G.E. Alternator, with exciter. Also compound Engine.

200 K.W. 3 Phase

Revolving field type "ATB" 2300 volt, G.E. Alternator, with exciter. Also compound Engine.

Duzets & Son **Electrical and Steam Machinery**

50 Church St., New York

DIRECT CONNECTED UNITS—BARGAINS

Brand new 500 K.W. Crocker Wheeler 250-volt, dir. con. to 22 and 40 x 42″ Cooper Corliss cross compound engine. Immediate delivery.

IN OPERATION FOR DELIVERY ABOUT JAN., 1910

200 K.W., 125-volt Crocker Wheeler D. C. to 20″ x 20″ McEwen engine.
Three 100 K.W. 125-volt G. E., D. C. to 14½ x 16″ Buckeye engines.
25 K.W., 125-volt Westinghouse, D. C. to Westinghouse engine.
Four 250 K.W., 2300-volt Alt. Cur., 2-phase, 60-cycle, D. C. to Westinghouse compound engines.

ALL WITH SWITCHBOARD EQUIPMENT

Will sacrifice for sale before shipping to our warehouse. The following at our Pittsburg, Pa., warehouse; immediate delivery:
200 K.W. Westinghouse 125–250-volt, D. C. to 16 and 28 x 18″ Erie Ball cross compound vertical engine.
100 K.W. Triumph, 250-volt, D. C. to 16 x 16″ Brownell engine.
50 K.W. Commercial, 125-volt, D. C. to 11 x 14″ Buckeye engine.
30 K.W., 115-volt Western Electric, D. C. to 10 x 10″ engine.
27½ K.W., 115-volt Commercial, D. C. to two-cylinder 7 x 6″ engine.
Just received carload very fine motors.
Get our complete list electrical equipment, engines, boilers, etc.

Saginaw, Mich. **WICKES BROTHERS,** **Pittsburg, Pa.**

Your 1910 Campaign!

A conservative estimate of the annual American electrical expenditure is one billion two hundred millions of dollars ($1,200,000,000).

The product of the electrical manufacturing companies in this country for one year is estimated at three hundred million dollars ($300,000,000).

There is every reason to believe that 1910 will be at least as good as and probably better than the average year. During the year the men who spend this $300,000,000 will use ELECTRICAL WORLD to ascertain where they can purchase their generators, motors, engines, turbines, lamps, instruments, switchboards, switches, transformers, poles, wire, cable and everything else they use in their central stations, their power-houses, shops, stores, factories, out in the field or anywhere else.

☛ Are *you* going to bid for your share of that $300,000,000?

In other words are you going to be represented in ELECTRICAL WORLD? Not merely "represented" by a card announcing what you make and where you are, but by a forceful appeal to the purchaser, by a well written, well set, good live-selling talk advertisement?

If so, you need the proper amount of space to devote to it, not too small, nor yet too large a space for the product to be considered.

You also need the right kind of "copy," the kind that not only tells a man *why* he ought to buy what you are offering him, but *induces* him to go thoroughly into its merits before purchasing.

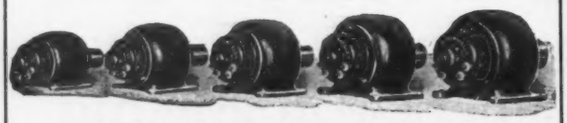
> The first issue of 1910 will be one of the biggest and most important issues of the year; it is the one in which to begin your active campaign; it will have a circulation of **25,000,** and every copy a "live wire."

How much space do you want in it? And —can we help you in preparing your copy?

If so, let us hear from you at once so that we can give the matter the attention it deserves.

Electrical World

Our Form L Motor



The Celebrated Form L Motor. 1-20 to 7 1-2 H.P.

cannot be improved upon in the present state of the art.

We have successfully built direct current motors since 1888.

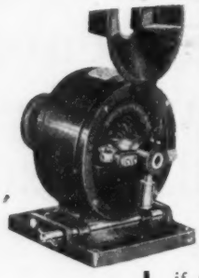
See Bulletin 118L.

Crocker-Wheeler Company

A.C. and D.C. Machinery

Ampere, N. J.

We make small motors for an infinite variety of drive!



We make nothing but small motors—ranging from 1/30 to 15 H.P. Direct Current—we make them for practically every type of machine used.

We are almost sure to have one especially adaptable to your business—if not, we have the machinery to make it on short notice with little additional cost.

Write us about your needs; how much power you require; how many machines you use; and our engineering department will tell you how much you can save in power, floor space, up-keep expense, and how much additional operating efficiency you can secure by the installation of individual motors in your work-shop.

This information is yours for the asking—obligates you in no way to install Robbins & Myers equipment if you do not wish to; and it will be valuable to you in your business whether you use R. & M. Motors or not.

Write for it to-day. Address

The Robbins & Myers Company

Factory and General Offices:

Springfield, Ohio

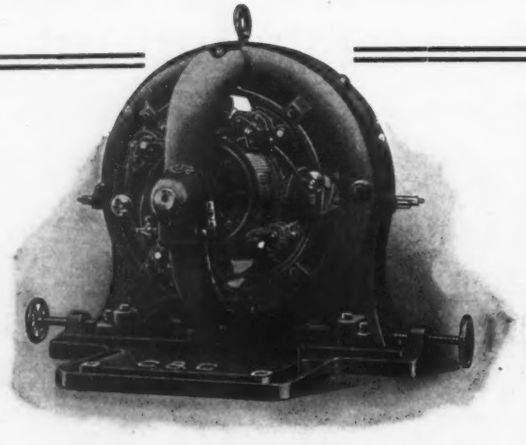
Branches:

New York, Boston, Philadelphia, Chicago

Agencies in all principal cities

Robbins & Myers Motors

Direct Current—all purposes—1/30 to 15 H. P. 1



C & C Dynamos and Motors

40,000 IN OPERATION

GARWOOD ELECTRIC COMPANY

SOLE MANUFACTURERS

Main Office and Works: Garwood, N. J.

New York: 149 Broadway.
Boston: 176 Federal St.
Atlanta, Ga.: Atlanta Brokerage Co.
Seattle, Wash.: Montilius Price Co.
Philadelphia: West End Trust Bldg.
Chicago: Tucker Electric Co., 970 Old Colony Bldg.
St. Louis: Bank of Commerce Bldg.
Charlotte, N. C.: Charlotte Contract Co.
Canada: Fellowes & Fellowes, Lawler Bldg. Toronto.

BARGAINS

Alternating and direct current motors, dynamos, also plating dynamos at bargain prices. All makes and sizes sold, bought and repaired.

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N. E. Cor. Ubera and Columbia Aves., Philadelphia, Pa.

READY TO SHIP

Generators—A. C.

350 K.W., G.E., 60 cycle, dr. cn. 3 ph.
250 K.W., West. 60 cycle, dr. cn. 2 ph.
150 K.W., G.E., A.T.B., 60 cycle, belted, 3 ph.

Generators—D. C.

200 K.W., G.E., 250 v., dr. cn.
150 K.W., G.E., 125 v., dr. cn.
100 K.W., W.E., 125 v., belted.

Engines—Corliss

26x48 Allis.
22x42 Allis.
20x42 Murray.
18x42 Hamilton.

W. T. Boilers

1200 H.P., 140 lb. to 150 lb. steam.

Partial list only.

Advise us your wants.

Station Equipment Company, 1228 Marquette Bldg., Chicago, Ill.

FOR SALE

455 Multiple Arc Lamps, viz.:

101 Form 3, 34 Form 5, 92 Form 6 and 147 Form 7, General Electric; 76 Adams-Bagnall and 5 No. 642 Upton; 6 amp., 110 volts, 60 to 125 cycles. In good condition. A bargain. Address,

The West Penn Electric Company

CONNELLSVILLE, PA.

WANTED

150 K.W. Alternator, 3 phase, 60 cycle, 2300 volts, belted, with or without exciter and switchboard. Give full description and net price. Address,

No. 6428, Care of Electrical World, New York

Have You the Five Best Wiring Handbooks?

Standard Handbook for Electrical Engineers

Written and compiled by a staff of specialists. Second edition, corrected. *Morocco*, 1300 *pages*, 4 *x* 6½, 1300 *illustrations*, *thumb index*, $4.00 (17*s.*) *net*, *postpaid*.

The leading authority and reference book in the electrical field.

One of the best sections is devoted exclusively to wiring—and, as a whole, the book is full of reference material of just the kind the practical man needs.

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Wiring Methods—Exposed; Concealed Knob and Tube; Moulding; Tubing; Conduit. Distribution Systems. Heating Circuits. Arc Lamp Circuits. Wiring Calculations D. C. Wiring Calculations A. C. Drop in Circuits. Motor Connections. Incandescent Lamp Circuits. Telephone Wiring. Bell Wiring. Gas-Lighting Wiring. Burglar-Alarm Wiring.

It has in addition nineteen sections, each prepared by a specialist under the guidance of an expert editorial staff. The result is a compact, authoritative reference book, without padding or repetition, and revised constantly, so that it is always up to date.

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By C. E. KNOX, E.E., Member A. I. E. E., Past Vice-President N. Y. Electrical Society. 225 *pages*, 6 *x* 9, 119 *illustrations*, $2.00 (8/6) *net*, *postpaid*.

Presenting the subject so as to be available and intelligible to one having only a general knowledge of electricity. Technical accuracy is not sacrificed and most of the data have never been published.

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CONTENTS: CHAPTER I—Shop System for Electrical Contractors. II—Estimating on Contract Work. III—Wiring Systems. IV—Exposed Circuit Wiring. V—Wiring with Wooden Moldings. VI—Wiring with Flexible Conduit and Armored Cable. VII—Wiring with Iron Conduit. VIII—Residence Wiring. IX—Wiring for Direct-Current and Alternating-Current Motors. X—Installation and Operation of Direct-Current Belted Generators and Switchboards. XI—Electric Signals and Telephone Systems. XII—Special Lighting Devices.

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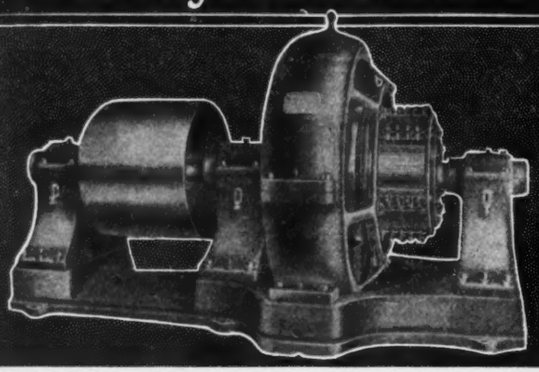

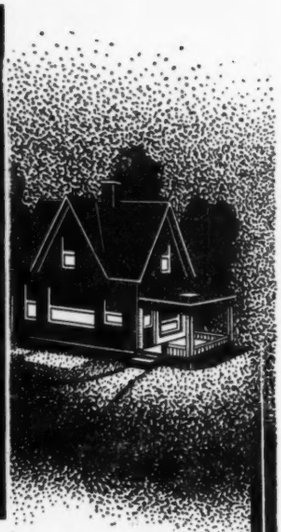

Power and Light Service that Gives Satisfaction

must be absolutely uniform under all reasonable conditions. Such service must be continuous--not occasional.

This throws a mighty lot of responsibility on the Generator and if it's "not on the job" all the time your customers get sore.

When you buy a Generator there is one sure way of getting a machine that will give service that suits both yourself and your customers. Look for the name "Fort Wayne" on it.

If you will send for our Bulletin B1050 it will explain the many reasons why our name on a Generator stands for the highest quality attainable.

Fort Wayne Electric Works; Main Office, Fort Wayne, Ind.

Atlanta Boston Cincinnati Chicago Grand Rapids Madison Milwaukee New York New Orleans Pittsburg Philadelphia Seattle St. Louis St. Paul San Francisco Syracuse

C2

Attention to details of design and construction insures the successful operation of

Eck Motors and Dynamos

½ to 20 H.P. direct current

Our bulletins describe them

ECK DYNAMO & MOTOR CO.
BELLEVILLE, N. J.

2

The Only Limit

of overload for the

Inter-Pole Motor

is heating, and this depends only on the duration of the overload. Before we introduce the Inter-Pole, sparking was the limit. Inter-Pole Motors are lighter and smaller than any others on the market. Our bulletins go into detail. Shall we send them?

ELECTRO DYNAMIC CO., BAYONNE, N. J.

Arcade Bldg., Philadelphia, Pa. 200 Ninth Street, Pittsburg
275 La Salle Street, Chicago

LET OUR MOTORS DO YOUR WORK

Burke Electric Company

Main Office and Works, ERIE, PA.

New York, 26 Cortlandt St.; Pittsburg, Park Bldg.; Cleveland, Adams & Downs, New England Bldg.; Chicago, Mr. F. R. Babcock, Marquette Bldg.; Kansas City, W. T. Osborn & Co.; Philadelphia, West End Trust Bldg.

Multipolar Motor

Constant and Variable Speed Motors

Of superior electrical and mechanical design.

Direct Current Motors from 1/30 H.P. to 30 H.P. for every requirement. Motor-generator sets, rotary converters, desk and ceiling fan motors.

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Branches in all principal cities.

"Peerless Motors are Good Motors." Send for Bulletins.

TRIUMPH MOTOR DRIVES

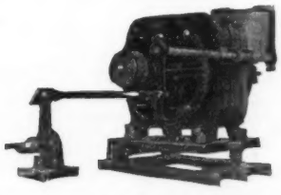
The choice of the proper motor, the best form of drive, etc., are points that need to be carefully considered.

The Triumph Electric Co. have had sixteen years' experience with this kind of work and you cannot do better than utilize their experience.

Bulletin 341 illustrates many kinds of drive.
Our adjustable speed motors are noted for quality.

The Triumph Electric Co.

Cincinnati, Ohio



This Motor Solves A. C. Problems

Variable Speed is easy to secure if you are on a D. C. circuit. But if you use A. C., you are having your troubles to get Variable Speed with old-fashioned A. C. Motors.

KIMBLE MOTORS

avoid these troubles. They give you reversible and Variable Speed, with one lever—without starting coils, resistance box, compensators or clutches. Any speed from 300 to 2000 R. P. M.

The Starting Current does not exceed the running current, and the running current varies with the speed.

Guaranteed for Two Years.

Write for Catalog "D"

KIMBLE ELECTRIC COMPANY
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Diehl
TRADE MARK

MOTORS can be attached to any make of

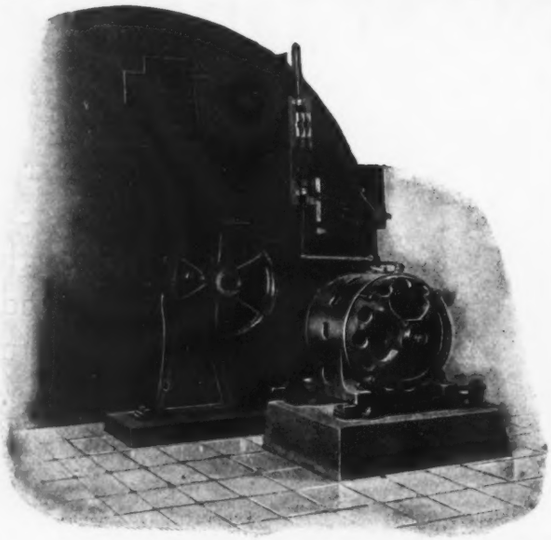
EXHAUST FANS

MOTOR AND BLACKMAN WHEEL
Fully described in Bulletin 63

Diehl Manufacturing Company
ELIZABETHPORT, NEW JERSEY

BRANCHES:
New York Boston Philadelphia Chicago Baltimore

CENTURY SINGLE PHASE MOTORS



are successfully operating some of the largest installations of heating and ventilating plants in public buildings. When geared or direct connected to ventilating fans or blowers, they will give results of the very highest order.

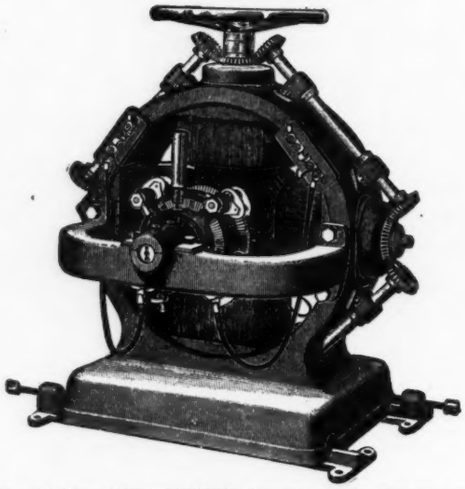
Century Electric Co.

19th and Olive Streets, ST. LOUIS, MO.

OUR MULTI-SPEED ELECTRIC MOTORS

are of the MULTI-POLAR form, from 5 H. P. up.

ESTABLISHED 1875



We call them MULTI-SPEED because speed changes are not made by steps, but an absolutely unbroken range is furnished between the highest and lowest points—in other words, every imaginable speed is given within these limits.

They will carry full load at all speeds within their range without sparking, with an efficiency practically as high at one speed as another. These results are arrived at without the use of rheostats or controllers. Let us mail you further details.

STOW MFG. CO., Binghamton, N. Y.

General European Agents.

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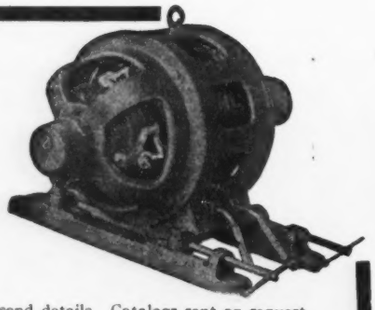
LINCOLN Single Phase MOTORS



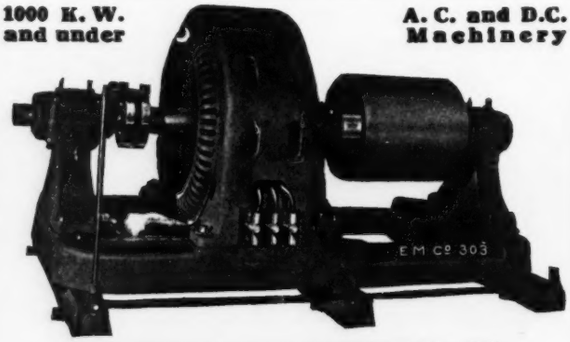
Self-starting under load. Torque up to four times full load torque at start. No phase splitters, governors or other complications found in other single-phase motors.

We shall be glad to send details. Catalogs sent on request.

Lincoln Electric Company, Kelley Ave. & 38th St., Cleveland, O.

Write to the nearest agent: Lincoln Electric Co., Lynn, Mass., Y.M.C.A. Bldg.; Muench Brothers, 230 Flatbush Ave., Brooklyn, N. Y.; Buffalo Electric Co., 17 W. Mohawk St., Buffalo, N.Y.; Crescent Electric Co., 24th St. & Spring Alley, Pittsburg, Pa.; Maton & Mitchell, Waterbury, Conn.; Central Electric Co., 264 Fifth Ave., Chicago, Ill.

1000 K. W. and under — **A. C. and D.C. Machinery**



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Motor Driven Milling Machine Changed from Line Shaft to Motor Drive

WE CAN CHANGE YOUR BELT DRIVEN MACHINES TO MOTOR DRIVE AND SAVE YOU MONEY AND TIME.

D. C. AND A. C.

Write for prices and Bulletins

The Mechanical Appliance Company

MILWAUKEE, WIS.

The most essential qualities of the high-grade modern American motors are combined in the SWING MOTOR. Standard sizes from ½ to 50 hp in Alternating and Direct Current

THE MOTOR WITH STAMINA

THE SWING ELECTRIC CO., 327 East 6th Street
Write for information. Cincinnati, U. S. A.

HIGH EFFICIENCY

SMALL D. C. MOTORS UP TO 3-4 H.P.

The Rossmassler-Bonine Electric Co.

PHILADELPHIA

The "LE CARBONE" Brush

is noted for minimum brush cost per k.w. hour. It causes the least possible wear on commutators, and effectively prevents flat spots and high mica.

Although its first cost is greater than that of other carbon brushes, it is far more economical in the long run.

Write to-day for partial list of Central Stations using "Le Carbone."

W. J. Jeandron, 22 Vesey Street New York 3

Better "Commutation"

is afforded by Dixon's Graphite Brushes, as they are self-lubricating and thus prevent wear on commutator.

Booklet 47-M tells more about them, we send it free on request.

Joseph Dixon Crucible Co.
Jersey City, N. J. 3

High-Grade Carbon Brushes

The heads of a thousand dynamo rooms state positively over official signature that LE VALLEY VITAE CARBON BRUSHES

Actually save their first cost again and again;
Save time, labor and annoyance;
Save commutators, keeping them unscratched and glossy;
Save shut-down losses and repair bills;
Save and make reputations for men and machinery;
Are in fact the one absolutely proven, generally admitted high-grade Carbon Brush, worthy of complete dependence and exclusive use in all places under all circumstances.

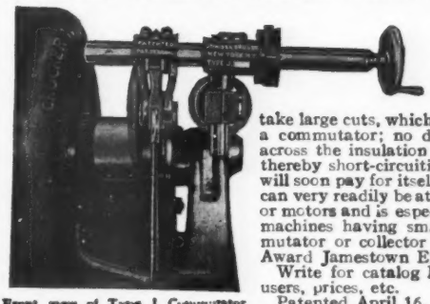
Le Valley Vitae Carbon Brush Co.
403 East 177th St., New York City
Catalogs and Testimonials on Application.

RICHMOND
Induction Motors
¼ to 100 H. P.
CONSTANT AND VARIABLE SPEED

Send for Bulletin No. 12

The Richmond Electric Company
Richmond, Va.

JORDAN COMMUTATOR TRUING DEVICE



Front view of Type J Commutator Truing Device attached to Crocker-Wheeler Motor.

This device will true your commutator without removing the armature; easy to attach and operate. Does not take large cuts, which shorten the life of a commutator; no dragging of copper across the insulation between the bars, thereby short-circuiting the same, and will soon pay for itself. This type device can very readily be attached to dynamos or motors and is especially intended for machines having small diameter commutator or collector ring. Silver Medal Award Jamestown Exposition.

Write for catalog No. 3, with list of users, prices, etc.

Patented April 16, 1898, and May 16, 1905, other patents pending.

Manufactured by
JORDAN BROTHERS, Inc., 74 Beekman St., N. Y. CITY

"The Tool-Monger"

Name given to a booklet of 288 pages which we shall be pleased to mail on request. Valuable to all users of Mechanics' Tools.

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Emerson Small Motors

Small motors all sizes $\frac{1}{10}$ to $\frac{1}{2}$ horsepower, single-phase or direct current. For all kinds of service.

A hundred types and windings regularly in stock at St. Louis and New York. Special types developed for special machines. Small motors for all purposes. Write for printed matter.

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THE PHOSPHOR BRONZE SMELTING CO.
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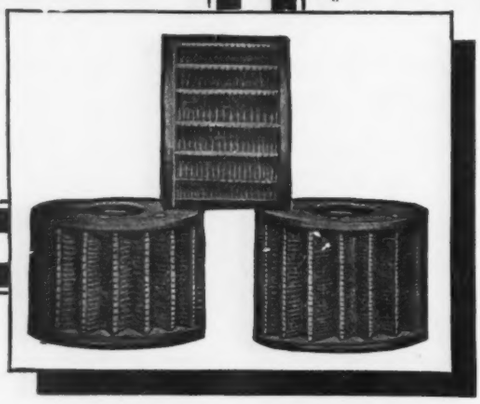
ELEPHANT BRAND *Phosphor Bronze*
INGOTS, CASTINGS, WIRE, SHEETS, RODS, Etc.
—DELTA METAL—
IN BARS FOR FORGING AND FINISHED RODS
ORIGINAL AND SOLE MAKERS IN THE U. S.

MOTORS {Constant Speed / Adjustable Speed / Vertical Shaft}

BLOWERS POLISHERS GRINDERS

ROTH BROS. & CO.
1400 W. ADAMS ST., CHICAGO, ILL.
136 Liberty St., N. Y.



They talk only in signs

No unpleasant sounds from geared motor drives equipped with

NEW PROCESS NOISELESS PINIONS

The signs they make look like this - - - - - - - - $ $ $ to the man who sells juice, sells motors or uses motors.

They eliminate the noise of metal-to-metal gear drives, reduce vibration, mesh accurately with cut metal gears and wear like iron.

The New Process Raw Hide Co.

Syracuse, N. Y. (1)

13 TO 23% RAILWAY POWER ECONOMY MUST INTEREST YOU. Are the following results worth anything to YOU?

1.—NO PERCEPTIBLE WEAR or adjustment required in such Bearings.
2.—Armatures will not run down on pole pieces as quite frequently happens with babbitt bearings, necessitating rewinding the whole armatures.
3.—Constancy of Air Gap.
4.—Good commutation ALWAYS.
5.—Reduction of gear wear.
6.—20% to 30% larger motor (for ordinary sizes) can be designed in the same space as occupied by a babbitt bearing motor, since Ball Bearings occupy much less space.

BEST OF ALL

YOU can have every one of these features at NO COST TO YOUR COMPANY since:

1.—Continuous service may be obtained from cars equipped with such motors, thereby increasing your annual car mileage per year and decreasing fixed charges on rolling stock per car-mile.

2.—No maintenance charges will arise that can in any way be attributed to the bearings, and lubricating will only be necessary twice a year.

3.—A 10% saving in energy can be obtained by the use of Ball Bearings on the motor armatures.

Any one of these three savings will alone pay the initial cost of a Ball Bearing installation and furnish a profit besides.

THE HESS-BRIGHT MANUFACTURING COMPANY
2112 Fairmount Avenue - - - RAILWAY DEPARTMENT - - - Philadelphia, Pa.

Slack Belts

Only Cling-Surface is permitting belts to be run slack and carry full loads in electric plants.

It is a preservative treatment for belts which keeps them pliable and waterproof and is not sticky.

We guarantee results. Write us.

Cling-Surface Company
1024 Niagara Street 4 Buffalo, N. Y.

IT DOES NOT TAKE A PAGE TO TELL OF

CARPENTER'S Machine Screw Taps

Oldest on the Market. None Superior. That's All.

TRADE MARK C Registered

We are prepared to furnish Machine Screw Taps and Dies to the New Standard adopted by the American Society of Mechanical Engineers.

The J. M. Carpenter Tap & Die Co.
PAWTUCKET, R. I., U. S. A.

THE ELECTRICAL WORLD'S
STREET-LIGHTING TABLES FOR 1910

These schedules are made up on local mean time. Where standard time is used, and it varies considerably from sun time, the proper deduction or addition must be made.

Time from noon until midnight is in bold-face type; that from midnight until noon in light type. The light type shows time for the morning following the date of the night indicated.

January, 1910

Night of	Table No. 1 All-Night Lighting		Table No. 2 Standard or Philadelphia System		Table No. 3 Frund System	
	Light	Exting.	Light	Exting.	Light	Exting.
1	**5:15**	6:20	**5:15**	**11:45**	**5:15**	**12:00**
2	**5:15**	6:20	**5:15**	12:45	**5:15**	12:45
3	**5:15**	6:20	**5:15**	1:40	**5:15**	1:40
4	**5:15**	6:20	**5:15**	2:40	**5:15**	2:40
5	**5:15**	6:20	**5:15**	3:40	**5:15**	3:40
6	**5:15**	6:20	**5:15**	4:40	**5:15**	4:40
7	**5:20**	6:20	**5:20**	5:50	**5:20**	5:50
8	**5:20**	6:20	**5:20**	6:20	**5:20**	6:20
9	**5:20**	6:20	**5:20**	6:20	**5:20**	6:20
10	**5:20**	6:20	**5:20**	6:20	**5:20**	6:20
11	**5:20**	6:20	**5:20**	6:20	**5:20**	6:20
12	**5:25**	6:20	**5:25**	6:20	**5:25**	6:20
13	**5:25**	6:20	**5:25**	6:20	**5:25**	6:20
14	**5:25**	6:20	**5:25**	6:20	**5:25**	6:20
15	**5:25**	6:15	**8:50**	6:15	**5:25**	6:15
16	**5:25**	6:15	**10:00**	6:15	**5:25**	6:15
17	**5:30**	6:15	**11:10**	6:15	**5:30**	6:15
18	**5:30**	6:15	12:20	6:15	**5:30**	6:15
19	**5:30**	6:15	1:35	6:15	**5:30**	**12:00**
19	.....	.....	.....	.....	1:35	6:15
20	**5:30**	6:15	2:45	6:15	**5:30**	**12:00**
20	.....	.....	.....	.....	2:45	6:15
21	**5:30**	6:15	3:55	6:15	**5:30**	**12:00**
21	.....	.....	.....	.....	3:55	6:15
22	**5:35**	6:15	5:00	6:15	**5:35**	**12:00**
23	**5:35**	6:15	No	light	**5:35**	**12:00**
24	**5:35**	6:15	No	light	**5:35**	**12:00**
25	**5:40**	6:10	No	light	**5:40**	**12:00**
26	**5:40**	6:10	**5:40**	**7:25**	**5:40**	**12:00**
27	**5:40**	6:10	**5:40**	**8:30**	**5:40**	**12:00**
28	**5:40**	6:10	**5:40**	**9:30**	**5:40**	**12:00**
29	**5:45**	6:10	**5:45**	**10:30**	**5:45**	**12:00**
30	**5:45**	6:10	**5:45**	**11:30**	**5:45**	**12:00**
31	**5:45**	6:05	**5:45**	**12:30**	**5:45**	12:30

February, 1910

Night of	Table No. 1 All-Night Lighting		Table No. 2 Standard or Philadelphia System		Table No. 3 Frund System	
	Light	Exting.	Light	Exting.	Light	Exting.
1	**5:45**	6:05	**5:45**	1:30	**5:45**	1:30
2	**5:45**	6:05	**5:45**	2:30	**5:45**	2:30
3	**5:45**	6:05	**5:45**	3:35	**5:45**	3:35
4	**5:45**	6:05	**5:45**	4:40	**5:45**	4:40
5	**5:50**	6:00	**5:50**	5:40	**5:50**	5:40
6	**5:50**	6:00	**5:50**	6:00	**5:50**	6:00
7	**5:55**	6:00	**5:55**	6:00	**5:55**	6:00
8	**5:55**	6:00	**5:55**	6:00	**5:55**	6:00
9	**5:55**	6:00	**5:55**	6:00	**5:55**	6:00
10	**5:55**	5:55	**5:55**	5:55	**5:55**	5:55
11	**6:00**	5:55	**6:00**	5:55	**6:00**	5:55
12	**6:00**	5:55	**6:00**	5:55	**6:00**	5:55
13	**6:00**	5:55	**9:00**	5:55	**6:00**	5:55
14	**6:05**	5:50	**10:10**	5:50	**6:05**	5:50
15	**6:05**	5:50	**11:25**	5:50	**6:05**	5:50
16	**6:05**	5:50	12:40	5:50	**6:05**	5:50
17	**6:10**	5:50	1:40	5:50	**6:10**	**12:00**
17	.....	.....	.....	.....	1:50	5:50
18	**6:10**	5:45	2:55	5:45	**6:10**	**12:00**
18	.....	.....	.....	.....	2:55	5:45
19	**6:10**	5:45	3:55	5:45	**6:10**	**12:00**
19	.....	.....	.....	.....	3:55	5:45
20	**6:10**	5:45	4:40	5:45	**6:10**	**12:00**
21	**6:10**	5:45	No	light	**6:10**	**12:00**
22	**6:10**	5:40	No	light	**6:10**	**12:00**
23	**6:15**	5:40	No	light	**6:15**	**12:00**
24	**6:15**	5:40	No	light	**6:15**	**12:00**
25	**6:15**	5:35	6:15	8:20	**6:15**	**12:00**
26	**6:15**	5:35	6:15	9:20	**6:15**	**12:00**
27	**6:15**	5:35	6:15	10:20	**6:15**	**12:00**
28	**6:20**	5:30	6:20	11:20	**6:20**	**12:00**

March, 1910

Night of	Table No. 1 All-Night Lighting		Table No. 2 Standard or Philadelphia System		Table No. 3 Frund System	
	Light	Exting.	Light	Exting.	Light	Exting.
1	**6:20**	5:30	**6:20**	12:20	**6:20**	12:20
2	**6:20**	5:30	**6:20**	1:20	**6:20**	1:20
3	**6:20**	5:30	**6:20**	2:20	**6:20**	2:20
4	**6:25**	5:30	**6:25**	3:25	**6:25**	3:25
5	**6:25**	5:25	**6:25**	4:20	**6:25**	4:20
6	**6:25**	5:20	**6:25**	5:15	**6:25**	5:15
7	**6:25**	5:20	**6:25**	5:20	**6:25**	5:20
8	**6:25**	5:20	**6:25**	5:20	**6:25**	5:20
9	**6:30**	5:20	**6:30**	5:20	**6:30**	5:20
10	**6:30**	5:15	**6:30**	5:15	**6:30**	5:15
11	**6:30**	5:15	**6:30**	5:15	**6:30**	5:15
12	**6:30**	5:15	**6:30**	5:15	**6:30**	5:15
13	**6:30**	5:10	**7:50**	5:15	**6:30**	5:10
14	**6:35**	5:10	**9:10**	5:10	**6:35**	5:10
15	**6:35**	5:10	**10:30**	5:10	**6:35**	5:10
16	**6:35**	5:05	**11:40**	5:05	**6:35**	5:05
17	**6:35**	5:05	12:50	5:05	**6:35**	5:05
18	**6:35**	5:05	1:50	5:05	**6:35**	**12:00**
18	.....	.....	.....	.....	1:50	5:05
19	**6:40**	5:05	2:45	5:00	**6:40**	**12:00**
19	.....	.....	.....	.....	2:45	5:00
20	**6:40**	5:00	3:25	5:00	**6:40**	**12:00**
21	**6:40**	5:00	4:00	5:00	**6:40**	**12:00**
22	**6:40**	4:55	4:30	4:55	**6:40**	**12:30**
23	**6:45**	4:55	No	light	**6:45**	**12:00**
24	**6:45**	4:55	No	light	**6:45**	**12:00**
25	**6:45**	4:55	No	light	**6:45**	**12:00**
26	**6:45**	4:50	**6:45**	**8:10**	**6:45**	**12:00**
27	**6:45**	4:50	**6:45**	**9:10**	**6:45**	**12:00**
28	**6:50**	4:50	**6:50**	**10:10**	**6:50**	**12:00**
29	**6:50**	4:45	**6:50**	**11:10**	**6:50**	**12:00**
30	**6:50**	4:45	**6:50**	12:15	**6:50**	12:15
31	**6:50**	4:45	**6:50**	1:15	**6:50**	1:15

April, 1910

Night of	Table No. 1 All-Night Lighting		Table No. 2 Standard or Philadelphia System		Table No. 3 Frund System	
	Light	Exting.	Light	Exting.	Light	Exting.
1	**6:50**	4:45	**6:50**	2:10	**6:50**	2:10
2	**6:55**	4:40	**6:55**	3:05	**6:55**	3:05
3	**6:55**	4:40	**6:55**	3:55	**6:55**	3:55
4	**6:55**	4:35	**6:55**	4:30	**6:55**	4:30
5	**6:55**	4:35	**6:55**	4:35	**6:55**	4:35
6	**6:55**	4:35	**6:55**	4:35	**6:55**	4:35
7	**7:00**	4:35	**7:00**	4:35	**7:00**	4:35
8	**7:00**	4:30	**7:00**	4:30	**7:00**	4:30
9	**7:00**	4:30	**7:00**	4:30	**7:00**	4:30
10	**7:00**	4:30	**7:00**	4:30	**7:00**	4:30
11	**7:00**	4:25	**7:00**	4:25	**7:00**	4:25
12	**7:05**	4:25	**7:05**	4:25	**7:05**	4:25
13	**7:05**	4:25	**10:35**	4:25	**7:05**	4:25
14	**7:05**	4:20	**11:45**	4:20	**7:05**	4:20
15	**7:05**	4:20	12:40	4:20	**7:05**	4:20
16	**7:05**	4:20	1:25	4:20	**7:05**	**12:00**
16	.....	.....	.....	.....	1:25	4:20
17	**7:10**	4:15	2:00	4:15	**7:10**	**12:00**
17	.....	.....	.....	.....	2:00	4:15
18	**7:10**	4:15	2:35	4:15	**7:10**	**12:00**
18	.....	.....	.....	.....	2:35	4:15
19	**7:10**	4:15	3:00	4:15	**7:10**	**12:00**
20	**7:10**	4:10	3:20	4:10	**7:10**	**12:00**
21	**7:10**	4:10	3:40	4:10	**7:10**	**12:00**
22	**7:15**	4:10	No	light	**7:15**	**12:00**
23	**7:15**	4:05	No	light	**7:15**	**12:00**
24	**7:15**	4:05	No	light	**7:15**	**12:00**
25	**7:15**	4:05	**7:15**	**9:00**	**7:15**	**12:00**
26	**7:20**	4:05	**7:20**	**10:05**	**7:20**	**12:00**
27	**7:20**	4:00	**7:20**	**11:05**	**7:20**	**12:00**
28	**7:20**	4:00	**7:20**	12:05	**7:20**	12:05
29	**7:20**	4:00	**7:20**	1:00	**7:20**	1:00
30	**7:20**	4:00	**7:20**	1:55	**7:20**	1:55

May, 1910

Night of	Table No. 1 All-Night Lighting		Table No. 2 Standard or Philadelphia System		Table No. 3 Frund System	
	Light	Exting.	Light	Exting.	Light	Exting.
1	**7:20**	4:00	**7:20**	2:30	**7:20**	2:30
2	**7:20**	4:00	**7:20**	3:10	**7:20**	3:10
3	**7:25**	3:55	**7:25**	3:45	**7:25**	3:45
4	**7:25**	3:55	**7:25**	3:55	**7:25**	3:55
5	**7:25**	3:55	**7:25**	3:55	**7:25**	3:55
6	**7:25**	3:50	**7:25**	3:50	**7:25**	3:50
7	**7:25**	3:50	**7:25**	3:50	**7:25**	3:50
8	**7:30**	3:50	**7:30**	3:50	**7:30**	3:50
9	**7:30**	3:45	**7:30**	3:45	**7:30**	3:45
10	**7:30**	3:45	**8:10**	3:45	**7:30**	3:45
11	**7:30**	3:45	**9:25**	3:45	**7:30**	3:45
12	**7:30**	3:45	**10:30**	3:45	**7:30**	3:45
13	**7:35**	3:45	**11:20**	3:45	**7:35**	3:45
14	**7:35**	3:45	**12:00**	3:45	**7:35**	3:45
15	**7:35**	3:40	12:35	3:40	**7:35**	3:40
16	**7:35**	3:40	1:05	3:40	**7:35**	**12:00**
16	.....	.....	.....	.....	1:05	3:40
17	**7:35**	3:40	1:25	3:40	**7:35**	**12:00**
17	.....	.....	.....	.....	1:25	3:40
18	**7:40**	3:40	1:50	3:40	**7:40**	**12:00**
18	.....	.....	.....	.....	1:50	3:40
19	**7:40**	3:40	2:10	3:40	**7:40**	**12:00**
20	**7:40**	3:40	2:30	3:40	**7:40**	**12:00**
21	**7:40**	3:40	2:50	3:40	**7:40**	**12:00**
22	**7:40**	3:35	No	light	**7:40**	**12:00**
23	**7:45**	3:35	No	light	**7:40**	**12:00**
24	**7:45**	3:35	No	light	**7:40**	**12:00**
25	**7:45**	3:35	**7:45**	**10:00**	**7:40**	**12:00**
26	**7:45**	3:35	**7:45**	**11:00**	**7:40**	**12:00**
27	**7:45**	3:35	**7:45**	**11:50**	**7:45**	**12:00**
28	**7:45**	3:35	**7:45**	12:35	**7:45**	12:35
29	**7:45**	3:35	**7:45**	1:10	**7:45**	1:10
30	**7:45**	3:30	**7:45**	1:45	**7:45**	1:45
31	**7:45**	3:30	**7:45**	2:10	**7:45**	2:10

June, 1910

Night of	Table No. 1 All-Night Lighting		Table No. 2 Standard or Philadelphia System		Table No. 3 Frund System	
	Light	Exting.	Light	Exting.	Light	Exting
1	**7:50**	3:35	**7:50**	2:40	**7:50**	2:40
2	**7:50**	3:35	**7:50**	3:00	**7:50**	3:00
3	**7:50**	3:35	**7:50**	3:30	**7:50**	3:30
4	**7:50**	3:35	**7:50**	3:35	**7:50**	3:35
5	**7:50**	3:35	**7:50**	3:35	**7:50**	3:35
6	**7:55**	3:35	**7:55**	3:35	**7:55**	3:35
7	**7:55**	3:35	**7:55**	3:35	**7:55**	3:35
8	**7:55**	3:35	**7:55**	3:35	**7:55**	3:35
9	**7:55**	3:35	**7:55**	3:35	**7:55**	3:35
10	**7:55**	3:35	**9:55**	3:35	**7:55**	3:35
11	**7:55**	3:35	**10:35**	3:35	**7:55**	3:35
12	**7:55**	3:30	**11:05**	3:30	**7:55**	3:30
13	**7:55**	3:30	**11:30**	3:30	**7:55**	3:30
14	**7:55**	3:30	**11:50**	3:30	**7:55**	3:30
15	**7:55**	3:30	12:15	3:30	**7:55**	3:30
16	**7:55**	3:30	12:35	3:30	**7:55**	3:30
17	**8:00**	3:30	12:55	3:30	**8:00**	3:30
18	**8:00**	3:30	1:20	3:30	**8:00**	**12:00**
18	.....	.....	.....	.....	1:20	3:30
19	**8:00**	3:30	1:50	3:30	**8:00**	**12:00**
19	.....	.....	.....	.....	1:50	3:30
20	**8:00**	3:30	No	light	**8:00**	**12:00**
21	**8:00**	3:30	No	light	**8:00**	**12:00**
22	**8:00**	3:30	No	light	**8:00**	**12:00**
23	**8:00**	3:30	**8:00**	**9:45**	**8:00**	**12:00**
24	**8:00**	3:30	**8:00**	**10:30**	**8:00**	**12:00**
25	**8:00**	3:30	**8:00**	**11:15**	**8:00**	**12:00**
26	**8:00**	3:30	**8:00**	**11:50**	**8:00**	**12:00**
27	**8:00**	3:30	**8:00**	**12:15**	**8:00**	12:15
28	**8:00**	3:30	**8:00**	**12:40**	**8:00**	12:40
29	**8:00**	3:30	**8:00**	1:05	**8:00**	1:05
30	**8:00**	3:30	**8:00**	1:30	**8:00**	1:30

July, 1910

Night of	Table No. 1 All-Night Lighting		Table No. 2 Standard or Philadelphia System		Table No. 3 Frund System	
	Light	Exting.	Light	Exting.	Light	Exting.
1	**8:00**	3:30	**8:00**	2:00	**8:00**	2:00
2	**8:00**	3:30	**8:00**	2:30	**8:00**	3:30
3	**8:00**	3:30	**8:00**	3:15	**8:00**	3:30
4	**8:00**	3:30	**8:00**	3:30	**8:00**	3:30
5	**8:00**	3:30	**8:00**	3:30	**8:00**	3:30
6	**8:00**	3:30	**8:00**	3:30	**8:00**	3:30
7	**8:00**	3:30	**8:00**	3:30	**8:00**	3:30
8	**8:00**	3:30	**8:00**	3:30	**8:00**	3:30
9	**8:00**	3:35	**8:00**	3:35	**8:00**	3:35
10	**8:00**	3:35	**9:30**	3:35	**8:00**	3:35
11	**7:55**	3:35	**9:55**	3:35	**7:55**	3:35
12	**7:55**	3:35	**10:15**	3:35	**7:55**	3:35
13	**7:55**	3:35	**10:35**	3:35	**7:55**	3:35
14	**7:55**	3:40	**11:00**	3:40	**7:55**	3:40
15	**7:55**	3:40	**11:20**	3:40	**7:55**	3:40
16	**7:55**	3:40	**11:50**	3:40	**7:55**	3:40
17	**7:55**	3:45	12:15	3:45	**7:55**	3:45
18	**7:55**	3:45	1:00	3:45	**7:55**	3:45
19	**7:55**	3:45	1:40	3:45	**7:55**	**12:00**
20	**7:50**	3:45	No	light	**7:50**	**12:00**
21	**7:50**	3:45	No	light	**7:50**	**12:00**
22	**7:50**	3:45	No	light	**7:50**	**12:00**
23	**7:50**	3:50	**7:50**	**9:45**	**7:50**	**12:00**
24	**7:50**	3:50	**7:50**	**10:20**	**7:50**	**12:00**
25	**7:50**	3:50	**7:50**	**10:45**	**7:50**	**12:00**
26	**7:50**	3:50	**7:50**	**11:10**	**7:50**	**12:00**
27	**7:45**	3:50	**7:45**	**11:35**	**7:45**	**12:00**
28	**7:45**	3:55	**7:45**	12:05	**7:45**	12:05
29	**7:45**	3:55	**7:45**	12:30	**7:45**	12:30
30	**7:45**	3:55	**7:45**	1:10	**7:45**	1:10
31	**7:40**	3:55	**7:45**	1:50	**7:40**	1:50

August, 1910

Night of	Table No. 1 All-Night Lighting		Table No. 2 Standard or Philadelphia System		Table No. 3 Frund System	
	Light	Exting.	Light	Exting.	Light	Exting.
1	**7:40**	3:55	**7:40**	2:45	**7:40**	2:45
2	**7:40**	3:55	**7:40**	3:50	**7:40**	3:50
3	**7:40**	4:00	**7:40**	4:00	**7:40**	4:00
4	**7:40**	4:00	**7:40**	4:00	**7:40**	4:00
5	**7:35**	4:00	**7:35**	4:00	**7:35**	4:00
6	**7:35**	4:00	**7:35**	4:00	**7:35**	4:00
7	**7:35**	4:00	**7:35**	4:00	**7:35**	4:00
8	**7:35**	4:00	**8:20**	4:00	**7:35**	4:00
9	**7:30**	4:05	**8:40**	4:05	**7:30**	4:05
10	**7:30**	4:05	**9:00**	4:05	**7:30**	4:05
11	**7:30**	4:05	**9:25**	4:05	**7:30**	4:05
12	**7:30**	4:05	**9:50**	4:05	**7:30**	4:05
13	**7:25**	4:05	**10:15**	4:05	**7:25**	4:05
14	**7:25**	4:10	**10:50**	4:10	**7:25**	4:05
15	**7:25**	4:10	**11:35**	4:10	**7:25**	4:10
16	**7:25**	4:10	12:25	4:10	**7:25**	4:10
17	**7:20**	4:10	1:25	4:10	**7:20**	**12:00**
17	.....	.....	.....	.....	1:25	4:10
18	**7:20**	4:10	2:35	4:10	**7:20**	**12:00**
19	**7:20**	4:15	No	light	**7:20**	**12:00**
20	**7:15**	4:15	No	light	**7:15**	**12:00**
21	**7:15**	4:15	No	light	**7:15**	**12:00**
22	**7:15**	4:15	**7:15**	**9:15**	**7:15**	**12:00**
23	**7:15**	4:15	**7:15**	**9:40**	**7:15**	**12:00**
24	**7:10**	4:20	**7:10**	**10:05**	**7:10**	**12:00**
25	**7:10**	4:20	**7:10**	**10:35**	**7:10**	**12:00**
26	**7:10**	4:20	**7:10**	**11:05**	**7:10**	**12:00**
27	**7:05**	4:20	**7:05**	**11:50**	**7:05**	**12:00**
28	**7:05**	4:20	**7:05**	12:40	**7:05**	12:40
29	**7:05**	4:25	**7:05**	1:40	**7:05**	1:40
30	**7:05**	4:25	**7:05**	2:40	**7:05**	2:40
31	**7:00**	4:25	**7:00**	3:50	**7:00**	3:50

September, 1910

Night of	Table No. 1 All-Night Lighting		Table No. 2 Standard or Philadelphia System		Table No. 3 Frund System	
	Light	Exting.	Light	Exting.	Light	Exting.
1	**7:00**	4:25	**7:00**	4:25	**7:00**	4:25
2	**7:00**	4:25	**7:00**	4:25	**7:00**	4:25
3	**6:55**	4:30	**6:55**	4:30	**6:55**	4:30
4	**6:55**	4:30	**6:55**	4:30	**6:55**	4:30
5	**6:55**	4:30	**6:55**	4:30	**6:55**	4:30
6	**6:50**	4:30	**6:50**	4:30	**6:50**	4:30
7	**6:50**	4:30	**6:50**	4:30	**6:50**	4:30
8	**6:50**	4:30	**7:50**	4:30	**6:50**	4:30
9	**6:45**	4:35	**8:15**	4:35	**6:45**	4:35
10	**6:45**	4:35	**8:30**	4:35	**6:45**	4:35
11	**6:45**	4:35	**9:30**	4:35	**6:45**	4:35
12	**6:40**	4:35	**10:15**	4:35	**6:40**	4:35
13	**6:40**	4:35	**11:10**	4:35	**6:40**	4:35
14	**6:40**	4:35	12:10	4:35	**6:40**	4:35
15	**6:35**	4:40	1:20	4:40	**6:35**	**12:00**
16	**6:35**	4:40	2:35	4:40	**6:35**	**12:00**
17	**6:35**	4:40	No	light	**6:35**	**12:00**
18	**6:30**	4:40	No	light	**6:30**	**12:00**
19	**6:30**	4:45	No	light	**6:30**	**12:00**
20	**6:30**	4:45	**6:30**	**8:05**	**6:30**	**12:00**
21	**6:25**	4:45	**6:25**	**8:35**	**6:25**	**12:00**
22	**6:25**	4:45	**6:25**	**9:05**	**6:25**	**12:00**
23	**6:25**	4:45	**6:25**	**9:45**	**6:25**	**12:00**
24	**6:20**	4:50	**6:20**	**10:35**	**6:20**	**12:00**
25	**6:20**	4:50	**6:20**	**11:30**	**6:20**	**12:00**
26	**6:20**	4:50	**6:20**	12:35	**6:20**	12:35
27	**6:15**	4:50	**6:15**	1:35	**6:15**	1:35
28	**6:15**	4:55	**6:15**	2:45	**6:15**	2:45
29	**6:15**	4:55	**6:15**	3:50	**6:15**	3:50
30	**6:15**	4:55	**6:15**	4:55	**6:15**	4:55

October, 1910

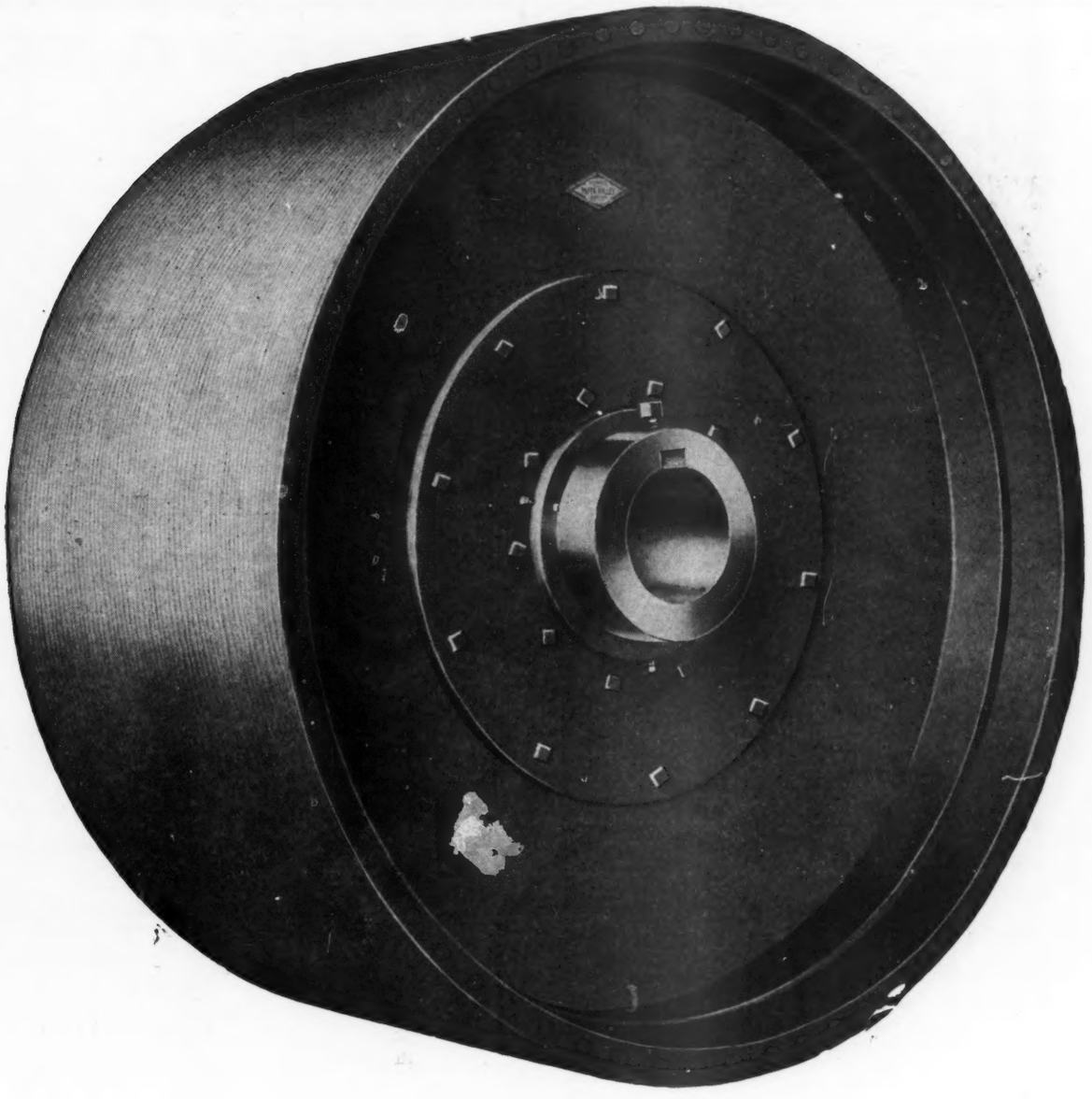
Night of	Table No. 1 All-Night Lighting		Table No. 2 Standard or Philadelphia System		Table No. 3 Frund System	
	Light	Exting.	Light	Exting.	Light	Exting.
1	**6:10**	4:55	**6:10**	4:55	**6:10**	4:55
2	**6:10**	4:55	**6:10**	4:55	**6:10**	4:55
3	**6:05**	5:00	**6:05**	5:00	**6:05**	5:00
4	**6:05**	5:00	**6:05**	5:00	**6:05**	5:00
5	**6:05**	5:00	**6:05**	5:00	**6:05**	5:00
6	**6:05**	5:00	**6:05**	5:00	**6:05**	5:00
7	**6:00**	5:00	**6:00**	5:00	**6:00**	5:00
8	**6:00**	5:05	**7:20**	5:05	**6:00**	5:05
9	**6:00**	5:05	**8:05**	5:05	**6:00**	5:05
10	**5:55**	5:05	**8:55**	5:05	**5:55**	5:05
11	**5:55**	5:05	**9:55**	5:05	**5:55**	5:05
12	**5:55**	5:05	**11:00**	5:05	**5:55**	5:05
13	**5:50**	5:10	12:10	5:10	**5:50**	5:10
14	**5:50**	5:10	1:20	5:10	**5:50**	**12:00**
14	.....	.....	.....	.....	1:20	5:10
15	**5:50**	5:10	2:35	5:10	**5:50**	**12:00**
16	**5:45**	5:10	3:45	5:10	**5:45**	**12:00**
17	**5:45**	5:10	No	light	**5:45**	**12:00**
18	**5:45**	5:15	No	light	**5:45**	**12:00**
19	**5:45**	5:15	No	light	**5:45**	**12:00**
20	**5:40**	5:15	**5:40**	**7:40**	**5:40**	**12:00**
21	**5:40**	5:15	**5:40**	**8:25**	**5:40**	**12:00**
22	**5:40**	5:20	**5:40**	**9:20**	**5:40**	**12:00**
23	**5:35**	5:20	**5:35**	**10:25**	**5:35**	**12:00**
24	**5:35**	5:20	**5:35**	**11:30**	**5:35**	**12:00**
25	**5:35**	5:20	**5:35**	12:35	**5:35**	12:35
26	**5:35**	5:20	**5:35**	1:45	**5:35**	1:45
27	**5:30**	5:25	**5:30**	2:50	**5:30**	2:50
28	**5:30**	5:25	**5:30**	3:50	**5:30**	3:50
29	**5:30**	5:25	**5:30**	4:55	**5:30**	4:55
30	**5:30**	5:25	**5:30**	5:25	**5:30**	5:25
31	**5:25**	5:30	**5:25**	5:30	**5:25**	5:30

November, 1910

Night of	Table No. 1 All-Night Lighting		Table No. 2 Standard or Philadelphia System		Table No. 3 Frund Syste	
	Light	Exting.	Light	Exting.	Light	Exting.
1	**5:25**	5:25	**5:25**	5:25	**5:25**	5:25
2	**5:25**	5:30	**5:25**	5:30	**5:25**	5:30
3	**5:25**	5:30	**5:25**	5:30	**5:25**	5:30
4	**5:20**	5:30	**5:20**	5:30	**5:25**	5:30
5	**5:20**	5:35	**6:00**	5:35	**5:25**	5:35
6	**5:20**	5:35	**6:50**	5:35	**5:25**	5:35
7	**5:20**	5:35	**7:45**	5:35	**5:25**	5:35
8	**5:20**	5:35	**8:45**	5:35	**5:25**	5:35
9	**5:15**	5:40	**9:50**	5:40	**5:25**	5:40
10	**5:15**	5:40	**11:00**	5:40	**5:25**	5:40
11	**5:15**	5:40	12:20	5:40	**5:25**	5:40
12	**5:15**	5:40	1:20	5:40	**5:15**	**12:00**
12	.....	.....	.....	.....	1:20	5:40
13	**5:15**	5:40	2:35	5:40	**5:15**	**12:00**
14	**5:10**	5:45	3:50	5:45	**5:10**	**12:00**
15	**5:10**	5:45	No	light	**5:10**	**12:00**
16	**5:10**	5:45	No	light	**5:10**	**12:00**
17	**5:10**	5:50	No	light	**5:10**	**12:00**
18	**5:10**	5:50	**5:10**	**7:10**	**5:10**	**12:00**
19	**5:10**	5:50	**5:10**	**8:10**	**5:10**	**12:00**
20	**5:10**	5:50	**5:10**	**9:15**	**5:10**	**12:00**
21	**5:05**	5:55	**5:05**	**10:25**	**5:05**	**12:00**
22	**5:05**	5:55	**5:05**	**11:35**	**5:05**	**12:00**
23	**5:05**	5:55	**5:05**	12:40	**5:05**	12:40
24	**5:05**	5:55	**5:05**	1:45	**5:05**	1:45
25	**5:05**	6:00	**5:05**	2:45	**5:05**	2:45
26	**5:05**	6:00	**5:05**	3:45	**5:05**	3:45
27	**5:05**	6:00	**5:05**	4:45	**5:05**	4:45
28	**5:05**	6:00	**5:05**	5:45	**5:05**	5:45
29	**5:05**	6:00	**5:05**	6:00	**5:05**	6:00
30	**5:05**	6:00	**5:05**	6:00	**5:05**	6:00

December, 1910

Night of	Table No. 1 All-Night Lighting		Table No. 2 Standard or Philadelphia System		Table No. 3 Frund System	
	Light	Exting.	Light	Exting.	Light	Exting
1	**5:05**	6:00	**5:05**	6:00	**5:05**	6:00
2	**5:05**	6:05	**5:05**	6:05	**5:05**	6:05
3	**5:05**	6:05	**5:05**	6:05	**5:05**	6:05
4	**5:05**	6:05	**5:05**	6:05	**5:05**	6:05
5	**5



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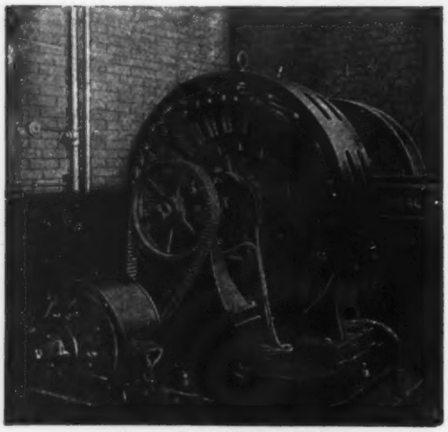

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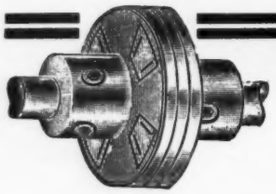

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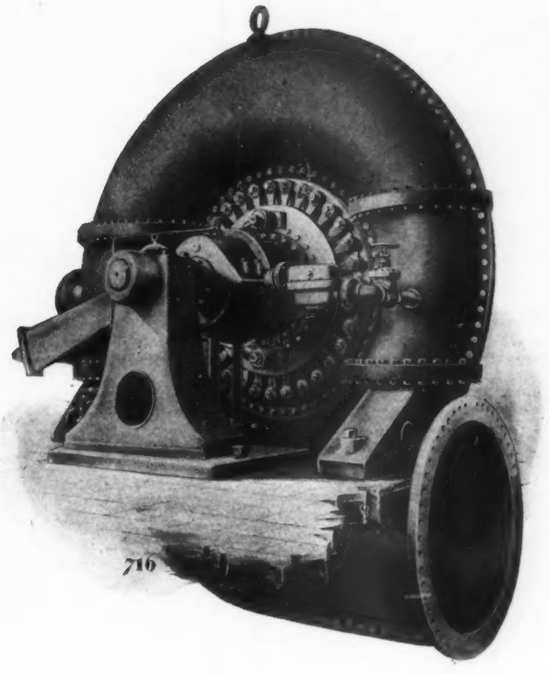

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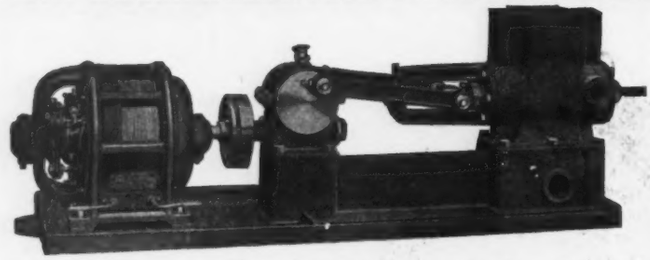

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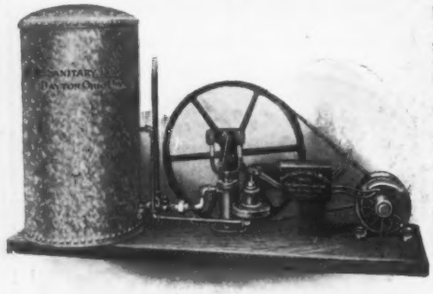

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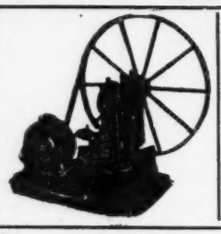

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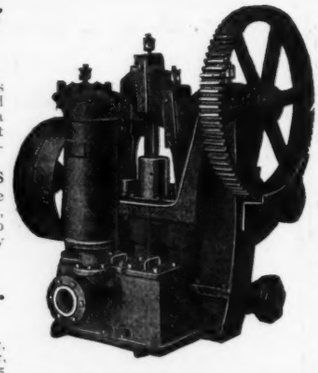

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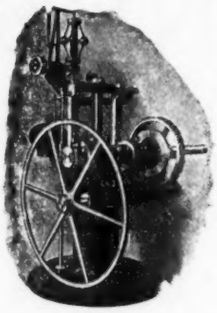

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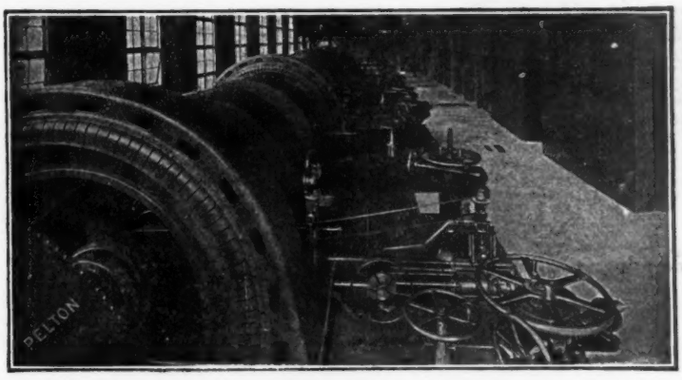

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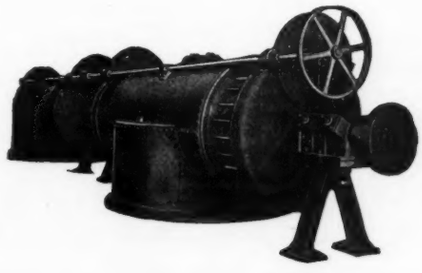

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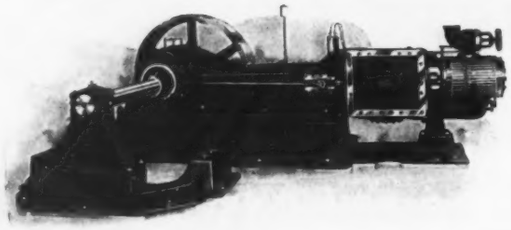

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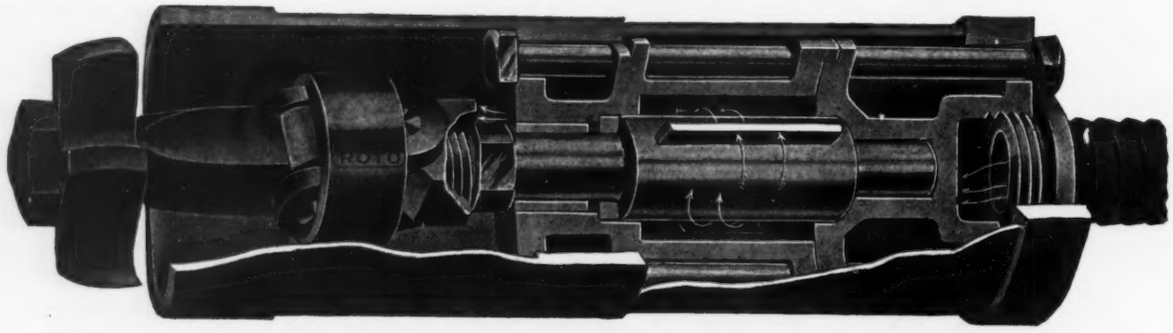

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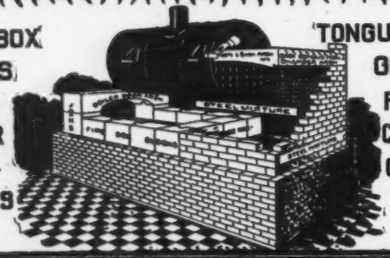

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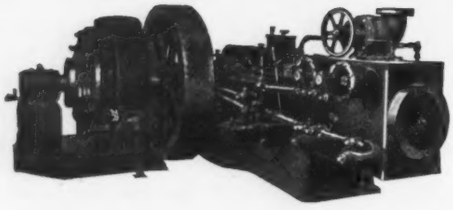

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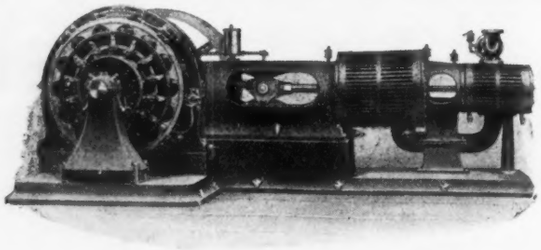

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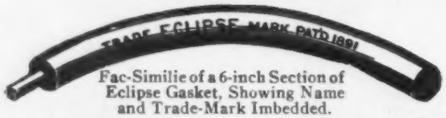

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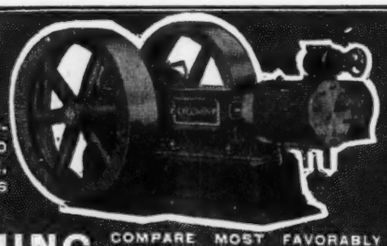

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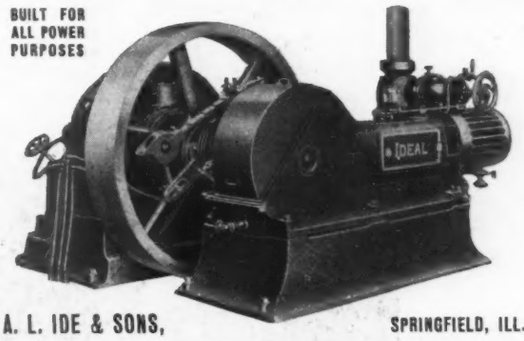

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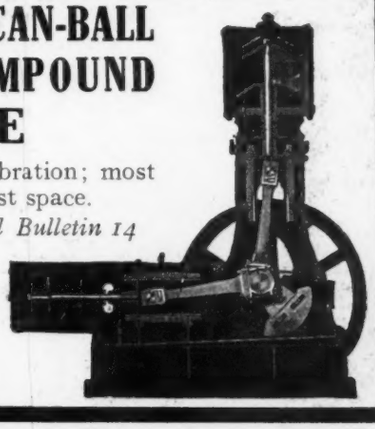

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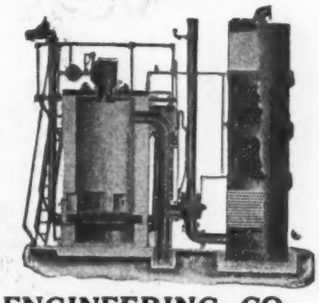

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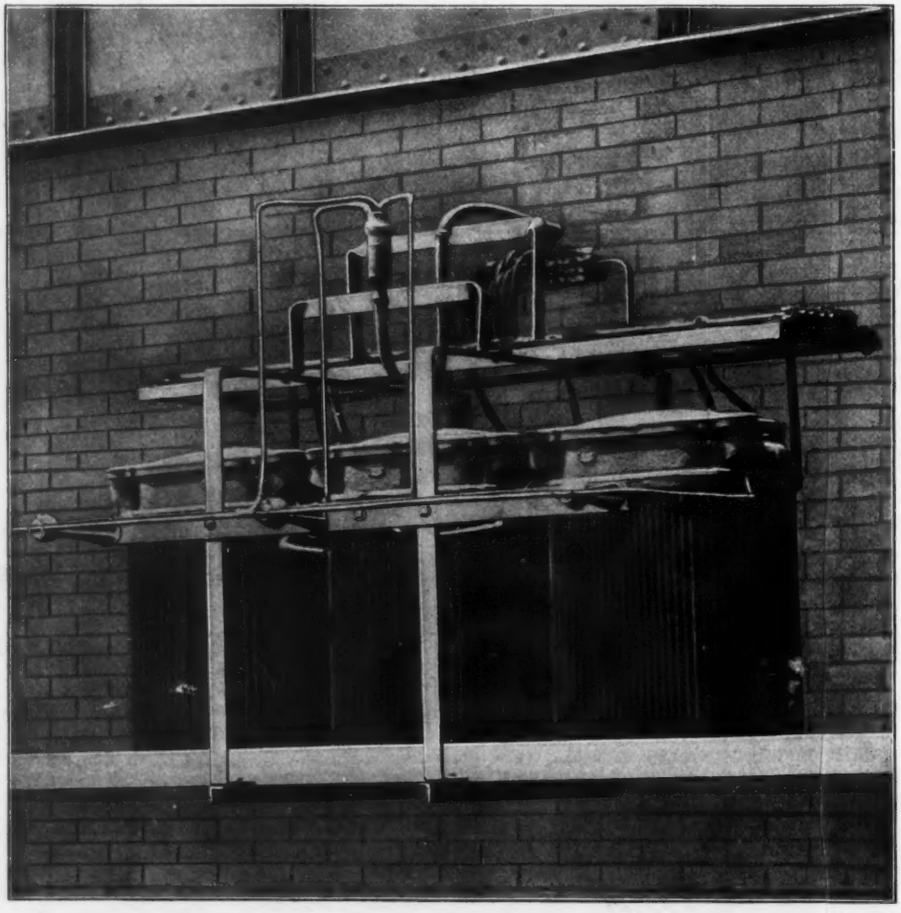

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